National Center of Forest Health Management

TECHNOLOGY
TRANSFER

Bibliography

Douglas Fir Tussock Moth Nucleopolyhedrosis Virus

TM-Biocontrol

Amy Onken
Richard Reardon

USDA Forest Service FHM-NC-06-94
December 1994

Pesticide Precautionary Statement

This publication reports on the use of pesticides. It does not contain recommendations for pesticide use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and Federal agencies before they can be recommended.

Caution: Pesticides may be injurious to humans, domestic animals, desirable plants, and fish or other wildlife, if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

The use of trade, firm, or corporation names in this publication is for the benefit of the reader. Such use does not constitute an endorsement or approval of any service or product by the U.S. Department of Agriculture to the exclusion of others that may be suitable.

TM BIOCONTROL BIBLIOGRAPHY

Bibliography Coordinators

Amy Onken
USDA Forest Service
Forest Health Protection
Morgantown, WV 26505

Richard Reardon
USDA Forest Service
National Center of Forest Health Management
Morgantown, WV 26505

Preface

This publication is the sixth in a series (FHM-NC-06-94) supported by the USDA Forest Service, Forest Health Protection and the National Center of Forest Health Management in Morgantown, WV.

The National Center of Forest Health Management was established in April 1993 for the purpose of accelerating development and use of environmentally acceptable technologies to improve the health of America's forests. The Center has national responsibility to address technology needs that are key for successful integrated pest management of major forest insects and diseases, and for the successful management of forest ecosystems.

Introduction

TM Biocontrol

A TM BIOCONTROL BIBLIOGRAPHY has been compiled by the National Center of Forest Health Management and will be updated and maintained by Forest Health Protection at the USDA Forest Service Laboratory in Morgantown, West Virginia. Searches from the computer-based bibliography can provide references for use in preparing environmental documents, answering public inquiries or to meet other needs of forest health managers. The TM BIOCONTROL BIBLIOGRAPHY can be searched for specific articles by author, year, or keyword. Currently the bibliography is organized in alphabetical order by author's last name and will be updated every 6 months.

File Description

The TM BIOCONTROL BIBLIOGRAPHY contains citations from the computerized information retrieval services, BIOSIS and AGRICOLA and manual searches. BIOSIS and AGRICOLA databases include over 9,000 primary journals and monographs, as well as technical reports, meeting abstracts, annual reviews, and research communications from 1969 to the present.

BIOSIS and AGRICOLA databases were scanned for records containing the subject "Nuclear Polyhedrosis Virus or Nucleopolyhedrosis Virus" that affect "Orgyia pseudotsugata". Abstracts are available, but only from records received from the BIOSIS database. Records received from AGRICOLA and manual searches contain only citations.

Format of TM Biocontrol Bibliography

Records of each citation are presented in the following format:

Author
Title of Article
Source
Full Journal Title
Abstract
Key words

Searching the Bibliography

A file search can be conducted in several ways. The value to be searched will return references that contain the value in the title, abstract or key words. Examples: Search for "chitin" would retrieve references that contained the word chitin. Search for "anni" would retrieve references that contained tannins, tannin, or mannitol. Search for "1988" would retrieve references that were published in 1988. Once a search is complete, the user can request that the references be printed or down loaded onto diskettes. Requests for an electronic copy of all references in the entire bibliography cannot be honored due to an agreement between the USDA Forest Service, BIOSIS, and AGRICOLA.

If you have any questions or would be interested in obtaining references from the TM BIOCONTROL BIBLIOGRAPHY, please contact:

Amy H. Onken
USDA Forest Service
Forest Health Protection
180 Canfield St.
Morgantown, WV 26505
(304)285-1541
FAX (304)285-1505

ADANG-M-J. SPENCE-K-D.
PERMEABILITY OF THE PERITROPHIC MEMBRANE OF THE *DOUGLAS-FIR* *TUSSOCK* *MOTH* *ORGYIA-PSEUDOTSUGATA.*
COMP BIOCHEM PHYSIOL A COMP PHYSIOL 75 (2). 1983. 233-238.
COMPARATIVE BIOCHEMISTRY AND PHYSIOLOGY A COMPARATIVE PHYSIOLOGY.
ABSTRACT
The peritrophic membrane of the *Douglas* *fir* *tussock* *moth,* O. *pseudotsugata,* is permeable to molecules and particulates up to the size of .gtoreq. 300 < 800 nm. Microorganisms the size of Bacillus thuringiensis and its spores cannot penetrate the intact peritrophic membrane. The pores exist which would allow penetration of such entities as nonoccluded virus, enveloped nucleocapsids of such microorganisms as O. *pseudotsugata* *nuclear* *polyhedrosis* virus and small bacteria. The dissociated entomocidal parasporal crystal of B. thuringiensis and the protease ficin were tested for possible effects on peritrophic membrane permeability. Although ficin increases permeability, the presence of I and 10 mg/ml crystal protein did not affect permeability of the membrane.

Keywords/ BACILLUS-THURINGIENSIS *NUCLEAR* *POLYHEDROSIS* VIRUS FICIN.

BANOWETZ-G-M; FRYER-J-L; IWAI-P-J; MARTIGNONI-M-E.
EFFECTS OF THE DOUGLAS-FIR TUSSOCK MOTH NUCLEOPOLYHEDROSIS VIRUS (BACULOVIRUS) ON THREE SPECIES OF SALMONID FISH
USDA FOR. SER. RES. PAP. PNW-214, 6P. 1976.
PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION, PORTLAND, OREGON

BERGOLD-G-H.
THE MOLECULAR STRUCTURE OF SOME INSECT VIRUS INCLUSION BODIES
J. ULTRASTRUCT. RES. 8: 1963. 360-378.
JOURNAL OF ULTRASTRUCTURAL RESEARCH

BICKNELL-J-N. LEISY-D-J. ROHRMANN-G-F. BEAUDREAU-G-S.
COMPARISON OF THE P26 GENE REGION OF TWO BACULOVIRUSES.
VIROLOGY 161 (2). 1987. 589-592.
VIROLOGY
ABSTRACT
A 1.1-kb region of DNA containing the p26 gene of the multicapsid *nuclear* *polyhedrosis* virus of *Orgyia* *pseudotsugata* (OpMNPV) was sequenced, transcriptionally mapped, and compared to the same region in the MNPV of Autographa californica (AcMNPV). The mRNA start site of the p26 gene occurs about 22 nucleotides downstream from an A/T-rich putative promoter sequence that is highly conserved between AcMNPV and OpMNPV. The p26 mRNA is transcribed through the p26 gene and coterminates with the p10 gene resulting in a mRNA containing copies of both genes. The reading frames of the OpMNPV and AcMNPV p26 genes showed 47% amino acid sequence homology which is clustered in six regions with over 65% amino acid homology. There was a distinct bias toward incorporation of G/C-rich codons in the OpMNPV p26 gene. No DNA homology was observed between the region upstream of the p26 gene inAcMNPV and OpMNPV. IN AcMNPV, this region contains the homologous repeated (hr) sequence hr5. Hybridization of a plasmid containing an AcMNPV-repeated sequence (hr5) to Southern blots of the OpMNPV genome indicated that this repeated sequence is lacking in OpMNPV.

Keywords/*ORGYIA-PSEUDOTSUGATA* *NUCLEAR* *POLYHEDROSIS* VIRUS AUTOGRAPHA-CALIFORNICA *NUCLEAR* *POLYHEDROSIS* VIRUS TRANSCRIPTION START SITE PROMOTER POLYCISTRONIC MESSENGER AMINO ACID SEQUENCE HOMOLOGY CODON USAGE BIAS NUCLEOTIDE SEQUENCE HOMOLOGY HOMOLOGOUS REPEAT SEQUENCE.

BIRNBAUM M J; CLEM R J; MILLER L K
AN APOPTOSIS-INHIBITING GENE FROM A NUCLEAR POLYHEDROSIS VIRUS ENCODING A POLYPEPTIDE WITH CYS-HIS SEQUENCE MOTIFS
JOURNAL OF VIROLOGY 68 (4). 1994. 2521-2528.
Full Journal Title: Journal of Virology
Language: ENGLISH
ABSTRACT
Two different baculovirus genes are known to be able to block apoptosis triggered upon infection of Spodoptera frugiperda cells with p35 mutants of the insect baculovirus Autographa californica nuclear polyhedrosis virus (AcMNPV): p35 (P35-encoding gene) of AcMNPV (R. J. Clem, M. Fechheimer, and L. K. Miller, Science 254:1388-1390, 1991) and iap (inhibitor of apoptosis gene) of Cydia pomonella granulosis virus (CpGV) (N. E. Crook, R. J. Clem, and L. K. Miller, J. Virol. 67:2168-2174, 1993). Using a genetic complementation assay to identify additional genes which inhibit apoptosis during infection with a p35 mutant, we have isolated a gene from Orgyia pseudotsugata NPV (OpMNPV) that was able to functionally substitute for AcMNPV p35. The nucleotide sequence of this gene, Op-iap, predicted a 30-kDa polypeptide product with approximately 58% amino acid sequence identity to the product of CpGV iap, Cp-IAP. Like Cp-IAP, the predicted product of Op-iap has a carboxy-terminal C3HC4 zinc finger-like motif. In addition, a pair of additional cysteine/histidine motifs were found in the N-terminal regions of both polypeptide sequences. Recombinant p35 mutant viruses carrying either Op-iap or Cp-iap appeared to have a normal phenotype in S. frugiperda cells. Thus, Cp-IAP and Op-IAP appear to be functionally analogous to P35 but are likely to block apoptosis by a different mechanism which may involve direct interaction with DNA.

Keywords/ RESEARCH ARTICLE; SPODOPTERA FRUGIPERDA; AUTOGRAPHA CALIFORNICA NUCLEAR POLYHEDROSIS VIRUS; CYDIA POMONELLA GRANULOSIS VIRUS; ORGYIA PSEUDOTSUGATA NUCLEAR POLYHEDROSIS VIRUS; MOLECULAR SEQUENCE DATA; NUCLEOTIDE SEQUENCE; AMINO ACID SEQUENCE; P35 GENE; OP-IAP GENE; CP-IAP GENE; HOMOLOGY; DIRECT DNA INTERACTION

BJORNSON-R-M. ROHRMANN-G-F.
NUCLEOTIDE SEQUENCE OF THE P39-CAPSID GENE REGION OF THE LYMANTRIA-DISPAR *NUCLEAR* *POLYHEDROSIS* VIRUS.
J GEN VIROL 73 (6). 1992. 1505-1508.
JOURNAL OF GENERAL VIROLOGY.
ABSTRACT
A 1.85 kb region, containing an open reading frame (ORF) homologous to the baculovirus p39-capsid gene, was sequenced from the lymantria dispar multicapsid *nuclear* *polyhedrosis* virus (LdMNPVj;enome. Analysis of the p39-capsid gene demonstrated that it was 39% and 47% identical in amino acid sequence with the homologous genes in the autographa californica and *Orgyia* *pseudotsugata* MNPVs, respectively. Two late promoter elements located upstream of the p39 gene in the LdMNPV genome are conserved with two other baculoviruses, whereas an ORF located downstream is not conserved.

Keywords/AUTOGRAPHA-CALIFORNICA *NUCLEAR* *POLYHEDROSIS* VIRUS *ORGYIA-PSEUDOTSUGATA* MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS HOMOLOGY CONSERVED LATE PROMOTERS NONCONSERVED DOWNSTREAM OPEN READING FRAME NUCLEOTIDE SEQUENCE AMINO ACID SEQUENCE MOLECULAR SEQUENCE DATA DDBJ-D10835 EMBL-D10835 GENBANK-D10835.

BLISSARD-G-W. KOGAN-P-H. WEI-R. ROHRMANN-G-F.
A SYNTHETIC EARLY PROMOTER FROM A BACULOVIRUS ROLES OF THE TATA BOX AND CONSERVED START SITE CAGT SEQUENCE IN BASAL LEVELS OF TRANSCRIPTION.

VIROLOGY 190 (2). 1992. 783-793.
VIROLOGY.
ABSTRACT
Many baculovirus early genes and insect genes transcribed by RNA polymerase II have a conserved transcription start site sequence (CAGT) located downstream of a consensus TATA box. To examine the functions and interactions of these two motifs in initiating accurately positioned basal transcription, a 43-nt synthetic promoter was synthesized from the TATA box and start site sequences of the gp64 early promoter from the *Orgyia* *pseudotsugata* multicapsid *nuclear* *polyhedrosis* virus (OpMNPV). The synthetic promoter initiated accurately and was also transactivated by the baculovirus transcriptional activator, IE1. To determine the roles of sequences within the 43-nt synthetic promoter, a series of linker-scanning and spacing mutations were analyzed for transcriptional activity, start site selection, and transactivation. Linker-scanning mutations were examined in vivo by transient expression and reporter gene assays. To examine transcription start site selection, promoter constructs were used for in vitro transcription in *nuclear* extracts from uninfected Spodoptera frugiperda (Sf9) cells. In vivo and in vitro analyses show that the TATA box, and not the start site CAGT, is the primary element controlling start site selection. Substitution of the conserved start site CAGT sequence resulted in a reduction of both reporter gene activity and in vitro transcripts, although transcripts initiated accurately. Data from linker-scanning and spacing mutations indicate that the conserved start site CAGT sequences are not required for accurate initiation but sequences at the start site play an important role in initiation efficiency.

Keywords/SPODOPTERA-FRUGIPERDA SF9 CELLS *ORGYIA-PSEUDOTSUGATA* MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS IE1 TRANSACTIVATION NUCLEOTIDE SEQUENCE MOLECULAR SEQUENCE DATA GENE REGULATION.

BLISSARD-G-W. QUANT-RUSSELL-R-L. ROHRMANN-G-F. BEAUDREAU-G-S.
NUCLEOTIDE SEQUENCE TRANSCRIPTIONAL MAPPING AND TEMPORAL EXPRESSION OF THE GENE ENCODING P39 A MAJOR STRUCTURAL PROTEIN OF THE MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS OF *ORGYIA-PSEUDOTSUGATA.*
VIROLOGY 168 (2). 1989. 354-362.
VIROLOGY.
ABSTRACT
The gene encoding the 39-kDa major structural protein (p39) of *Orgyia* *pseudotsugata* *nuclear* *polyhedrosis* virus (OpMNPV) was sequenced and transcriptionally mapped, and its expression was examined at various times postinfection. By Northern hybridization, primer extensoin, and S1 nuclease analysis, we identified p39 mRNAs of approximately 2600nt. By primer extension analysis, we identified two major sets of transcripts which initiated around -48 and -96 nt upstream of the translation start codon. The transcription start sites were located within the conserved baculovirus late gene consensus sequence, ATAAG, which is duplicated in the p39 5' flanking region. In OpMNPV-infected Lymantria dispar cells, the p39 mRNAs were expressed abundantly at 24 and 36 hr p.i. but were present in lower quantities at 48 hr p.i. The p39 gene contained an open reading frame of 1053 nt which encodes a predicted protein of 351 amino acids with an estimated molecular weight of 39.5 kDa. Three repeats of the amino acid sequence Ala-Pro-Ala-Ala-Pro were identified at the C-terminus of the predicted p39 protein.

Keywords/LYMANTRIA-DISPAR MOLECULAR SEQUENCE DATA AMINO ACID SEQUENCE DNA SEQUENCE POSTINFECTION EXPRESSION.

BLISSARD-G-W. ROHRMANN-G-F.
LOCATION SEQUENCE TRANSCRIPTIONAL MAPPING AND TEMPORAL EXPRESSION OF THE GP64 ENVELOPE GLYCOPROTEIN GENE OF THE *ORGYIA-PSEUDOTSUGATA* MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS.
VIROLOGY 170 (2). 1989. 537-555.
VIROLOGY.

ABSTRACT
The gene encoding gp64, the envelope glycoprotein of the budded virus (BV) of *Orgyia* *pseudotsugata* multicapsid *nuclear* *polyhedrosis* virus (OpMNPV), was mapped to the HindIII-E fragment of the viral genome and expression of the gp64 gene was examined at various times postinfection. To locate the gp64 gene, a cross-reacting monoclonal antibody (AcV5) (A.W. Hohmann and P. Faulkner, 1983, Virology, 125, 432-444) directed against the gp64 protein of the Autographa californica multicapsid *nuclear* *polyhedrosis* virus (AcMNPV) was used to screen a .lambda. gt11 expression library of OpMNPV and insert DNAs from immunopositive recombinants were used for Southern hybridization mapping. The gp64 gene was sequenced and transcription of the gp64 gene was examined by Northern blot, S1 nuclease, and primer extension analysis. Two sets of gp64 transcripts were detected during infection: a single early transcript which initiated at -43 nt and four late transcripts which initiated at -152, -167, -174, and -175 nt relative to the start of the gp64 open reading frame. Comparison of the gp64 early transcription initiation site with several other early baculovirus genes revealed a four-nucleotide consensus sequence (CAGT) which is conserved at the early transcription initiation sites of the IE-1 and 39K genes. The four late gp64 transcripts initiated at two of the four upstream ATAAG motifs. All gp64 mRNAs appear to be coterminal at the 3' end. Analysis of the nucleotide sequence of the gp64 gene revealed that the late gp64 mRNAs are bicistronic, consisting of a three amino acid minicistron located 70 nt upstream of the 509 amino acid gp64 open reading frame. Early transcripts do not contain the minicistron. The 1527-nt gp64 open reading frame encodes a predicted protein of 509 amino acids with a molecular weight of 58 kDa. The predicted gp64 protein contains seven potential N-linked glycosylation sites and hydrophobic N- and C-termini characteristic of signal and membrane anchor sequences found on envelope glycoproteins. By western blot analyses and indirect immunofluorescence microscopy, we show that the gp64 protein is present at early times (6 hr) postinfection and accumulates in the infected cell, mo{ing to the periphery at later times postinfection. Western blot comparisons of the temporal expression of the gp64 protein with the p39 capsid protein revealed that these two virion structural protein genes differ significantly in the timing of their initial expression. The upstream regulatory regions, open reading frames, and predicted proteins from the OpMNPV and AcMNPV gp64 genes were compared. In the upstream regulatory region, three sequences were highly conserved: (a) sequences surrounding the upstream late promoter (ATAAG) motif, (b) sequences including a putative TATA box of an early promoter, and (c) sequences containing the early transcription initiation site. The two predicted amino acid sequences show 78% amino acid identity. Evolutionary implications of the conservation between the two genes are discussed.

Keywords/AUTOGRAPHA-CALIFORNICA MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS OPEN READING FRAME TRANSCRIPTION INITIATION SITE BICISTRONIC MESSENGER RNA EARLY TRANSCRIPT LATE TRANSCRIPT UPSTREAM REGULATORY REGION MOLECULAR SEQUENCE DATA NUCLEOTIDE SEQUENCE PROTEIN SEQUENCE GENBANK-M22446 EMBL-M22446 DDBJ-M22446.

BLISSARD-G-W. WENZ-J-R.
BACULOVIRUS GP64 ENVELOPE GLYCOPROTEIN IS SUFFICIENT TO MEDIATE PH-DEPENDENT MEMBRANE FUSION.
J VIROL 66 (11). 1992. 6829-6835.
JOURNAL OF VIROLOGY.
ABSTRACT
The baculovirus gp64 envelope glycoprotein is a major component of the envelope of the budded virus (BV) and is involved in B entry into the host cell by endocytosis. To determine whether gp64 alone was sufficient to mediate membrane fusion, the *Orgyia* *pseudotsugata* multicapsid *nuclear* *polyhedrosis* virus gp64 protein was transiently expressed in uninfected insect cells. Cells expressing the baculovirus gp64 protein were examined for membrane fusion activity by using a syncytium formation assay under various conditions of exposure to low pH. Cells expressing the gp64 protein mediated membrane fusion and syncytium formation in a pH-dependent manner. A pH of 5.5 or lower was required to induce membrane fusion. In addition, exposure of gp64-expressing cells to low pH for as little as 5 s was sufficient to induce gp64-mediated syncytium formation. These studies provide direct evidence that gp64 is a pH-dependent membrane fusion

protein and suggest that gp64 is the protein responsible for fusion of the virion envelope with the endosome membrane during BV entry into the host cell by endocytosis.

Keywords/*ORGYIA-PSEUDOTSUGATA* MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS INSECT CELLS BUDDED VIRUS VIRION ENVELOPE ENDOSOME MEMBRANE ENDOCYTOSIS.

BRADFORD-M-B. BLISSARD-G-W. ROHRMANN-G-F.
CHARACTERIZATION OF THE INFECTION CYCLE OF THE *ORGYIA-PSEUDOTSUGATA* MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS IN LYMANTRIA-DISPAR CELLS.
J GEN VIROL 71 (12). 1990. 2841-2846.
JOURNAL OF GENERAL VIROLOGY.
ABSTRACT
To characterize the infection cycle of the *Orgyia* *pseudotsugata* multicapsid *nuclear* *polyhedrosis* virus in Lymantria dispar cells, the time course of DNA synthesis and polyhedron production, and the onset and rate of budded virus production were investigated at three different m.o.i. (5, 10 and 100). In addition, the time course of expression of three proteins (gp64, p39 and polyhedrin) representative of three temporal classes of baculovirus genes was also analysed using Western blot analysis. DNA synthesis began at 12 to 18 h post-infection (p.i.). The rate of budded virus (BV) production reached maximal levels at 24 to 36 h p.i. and continued at high levels indicating that BV production was not turned off late in infection. Polyhedra were first observed at 48 h p.i. The m.o.i. appeared to influence the magnitude but not timing of early events in the viral infection cycle (gp64 expression and DNA synthesis) and also influenced the initial levels of BV production and the percentage of cells containing occlusion bodies. The m.o.i. had little influence on the final rates of BV production and the time of detection of p39 and polyhedrin on Western blots.

Keywords/POLYHEDRIN EXPRESSION PROTEIN 39 EXPRESSION GLYCOPROTEIN 64 EXPRESSION DNA SYNTHESIS POLYHEDRON PRODUCTION BUDDED VIRUS PRODUCTION.

BURGES-H-D; THOMPSON-E-M.
STANDARDIZATION AND ASSAY OF MICROBIAL INSECTICIDES.
IN MICROBIAL CONTROL OF INSECTS AND MITES. 1971. P. 591-622
H. D. BURGES AND N. W. HUSSEY, EDS. ACAD. PRESS, LONDON AND NEW YORK

CANTWELL-G-E; LEHNERT-T; FOWLER-J.
ARE BIOLOGICAL INSECTICIDES HARMFUL TO THE HONEY BEE?
AM. BEE J. 112(7). 1972. 294-296
AMERICAN BEE JOURNAL

CHEN-D-D. NESSON-M-H. ROHRMANN-G-F. BEAUDREAU-G-S.
THE GENOME OF THE MULTICAPSID BACULOVIRUS OF *ORGYIA-PSEUDOTSUGATA* RESTRICTION MAP AND ANALYSIS OF TWO SETS OF GC-RICH REPEATED SEQUENCES.
J GEN VIROL 69 (6). 1988. 1375-1382.
JOURNAL OF GENERAL VIROLOGY.
ABSTRACT
Five cosmids containing inserts that comprise the complete genome of the multicapsid *nuclear* *polyhedrosis* virus of *Orgyia* *pseudotsugata* were mapped with four restriction enzymes (BglII, ClaI, SstI, XhoI). From these cosmid maps, composite maps of the complete genome were constructed for each restriction enzyme. A region containing repeats of the sequence GGC downstream of the polyhedrin gene was used to probe the genome. It cross-hybridized with a region which, upon sequence analysis, was found to be a highly repetitive GC-rich region of nearly 500 nucleotides. The two GC-rich regions appears to be evolutionarily unrelated.

CIESLA-W-M.
DOUGLAS-FIR *TUSSOCK* *MOTH* DIRECT CONTROL WITH CHEMICAL AND MICROBIAL INSECTICIDES.
BULL ENTOMOL SOC AM 23 (3). 1977. 174-176.
BULLETIN OF THE ENTOMOLOGICAL SOCIETY OF AMERICA.

Keywords/BACILLUS-THURINGIENSIS *NUCLEOPOLYHEDROSIS* VIRUS SEVIN DYLOX ORTHENE DIMILIN.

DAHLSTEN-D-L. LUCK-R-F. SCHLINGER-E-I. WENZ-J-M. COPPER-W-A.
PARASITOIDS AND PREDATORS OF THE *DOUGLAS-FIR* *TUSSOCK* *MOTH* *ORGYIA-PSEUDOTSUGATA* LEPIDOPTERA LYMANTRIDAE IN LOW TO MODERATE POPULATIONS IN CENTRAL CALIFORNIA USA.
CAN ENTOMOL 109 (5). 1977. 727-746.
CANADIAN ENTOMOLOGIST.
ABSTRACT
Douglas-fir *tussock* *moth,* O. *pseudotsugata* (McDunnough), populations were studied on white *fir* Abies concdor (Gord. and Glend.) Lindl. at 4 areas in central Sierra Nevada mountains of California USA during 1971-73. Life tables were constructed for 4 populations in El Dorado County. The number of eggs per egg mass decreased and the percentage eggs parasitized doubled with declining *moth* populations. Hymenopterous parasitoids were collected from all immature stages of the *moth:* one egg parasitoid, Telenomus californicus Ashmead, 6 spp. of larval parasitoids, principally, Hyposoter sp., and 13 spp. of larval-pupal parasitoids. Tachinids Carcelia yalensis Sellers were predominant and accounted for 73% of the parasitoidism of the cocoons in 1971. The apparent mortality of female pupae due to the parasitoid complex was greater than 97% in 1971 and 75% in 1972. One population of Placer County collapsed in 1971 apparently due to a combination of heat exhaustion and low levels of virus infection. Other defoliators Lepidoptera, sawflies, spiders, and several predatory insect species Coccinellidae and Pentotomidae were collected from the foliage samples simultaneously with the *tussock* *moth* during larval sampling. Twelve species of "free living" spiders which could be capable of preying on the defoliator complex of white *fir* were collected. Parasitoids and predators appear to be potentially important biotic factors at low to moderate host population levels. This is the 1st recorded case where an agent other than the *nucleopolyhedrosis* virus has been responsible for the collapse of a *Douglas-fir* *tussock* *moth* population.

Keywords/ABIES-CONCOLOR CARCELIA-YALENSIS TELENOMUS-CALIFORNICUS HYPOSOTER-SP SPIDERS COCCINELLIDAE PENTATOMIDAE *NUCLEOPOLYHEDROSIS* VIRUS SAWFLIES HEAT EXHAUSTION.

DAHLSTEN-D-L; THOMAS-G-M.
A NUCLEOPOLYHEDROSIS VIRUS IN POPULATIONS OF THE DOUGLAS-FIR TUSSOCK MOTH, HEMEROCAMPA PSEUDOTSUGATA IN CALIFORNIA
J. INVERT. PATHOL. 13(2). 1969. 264-271.
JOURNAL OF INVERTEBRTE PATHOLOGY

DWYER-G.
ON THE SPATIAL SPREAD OF INSECT PATHOGENS THEORY AND EXPERIMENT.
SO ECOLOGY 73 (2). 1992. 479-494.
ECOLOGY.
ABSTRACT

The mathematical theory of animal diseases has seen explosive growth in the past decade, yet most of the existing theory examines only temporal disease spread, ignoring the effects of patchy host or pathogen spatial distributions. Here I present a model for the within-season spatial spread of insect pathogens that incorporates host movement in an otherwise conventional insect host-pathogen model. Mathematical analysis of the model reveals that the pathogen will spread through the host population in a moving wave front of disease, known as a "travelling wave." This analysis shows how the spatial rate of spread of the pathogen depends upon the transmission rate of the disease, the rate of production of the pathogen by infected hosts, the initial population of the host, the decay rate of the pathogen, and the death rate of infected hosts. To test the predictions of the model, I performed a series of field experiments with the *nuclear* *polyhedrosis* virus (NPV) of *Douglas-fir* *tussock* *moth,* *Orgyia* *pseudotsugata.* First, I estimated each of the parameters of the model in the field with a series of small-scale experiments, and used the parameter estimates to predict the spatial rate of spread of the NPV through a population of *tussock* *moth* larvae (NPV diseases, like many insect pathogens, do not infect adults). To test this prediction, I then performed an experiment in which I measured the rate of spread of the NPV in an experimental population of *tussock* *moth* larvae on linear arrays of *Douglas-fir* seedlings. The model predicts the rate of spread of *tussock* *moth* NPV fairly accurately, suggesting that one can use this type of model to extrapolate individual behavior and localized transmission patterns to broader-scale spatial dynamics.

Keywords/*ORGYIA-PSEUDOTSUGATA* *NUCLEAR* *POLYHEDROSIS* VIRUS ANIMAL DISEASE TRANSMISSION RATE BIOLOGICAL CONTROL TRAVELING WAVE MATHEMATICAL THEORY MODELLING.

DWYER-G.
THE ROLES OF DENSITY STAGE AND PATCHINESS IN THE TRANSMISSION OF AN INSECT VIRUS.
ECOLOGY 72 (2). 1991. 559-574.
ECOLOGY.
ABSTRACT
Although the importance of insect viruses in the population dynamics of their hosts is widely acknowledged, ecologists are still relatively ignorant of the factors determining the rate of transmission of insect viruses in the field. I performed a series of field experiments in which I investigated the transmission dynamics of the *nuclear* *polyhedrosis* virus (NPY) of *Douglas-fir* *tussock* *moth,* *Orgyia* *pseudotsugata* (Lepidoptera: Lymantriidae), in northern Idaho, USA. In these experiments, I reared healthy and infected larvae together on seedling *Douglas-fir* (Pseudotsuga menziesii), and used the number of healthy larvae that became infected as a measure of transmission. I explored the influences of density, stage structure, and spatial structure on transmission by manipulating the density and stage distribution of healthy and infected hosts, and the spatial distribution of infected hosts. The experiments indicate that transmission is strongly affected the densities of both healthy and infected hosts, but the effect depends on the instar of each. Late instars are both more infectious and more likely to become infected than are early instars, so that the NPV is more likely to spread in populations of late-instar *tussock* *moth* larvae. I also found that transmission is affected by the spatial distribution of infected hosts, and this effect also depends on the instar of healthy hosts. That is, transmission to healthy early instars decreases with increasing patchiness of infected hosts, but transmission to healthy late instars is essentially unaffected by patchiness. I discuss how these results can be interpreted in terms of behavioral differences among instars, and relate the results to the mathematical theory of disease and the use of viruses in biological pest control.

Keywords/*ORYGIA-PSEUDOTSUGATA* PSEUDOTSUGA-MENZIESII *NUCLEAR* *POLYHEDROSIS* VIRUS LARVA INFECTIOUSNESS SUSCEPTIBILITY BEHAVIOR BIOLOGICAL CONTROL MATHEMATICAL EPIDEMIOLOGY IDAHO USA.

DWYER-G.
THE ECOLOGY OF AN INSECT VIRUS FROM MODELS TO EXPERIMENTS AND BACK AGAIN.

PERSPECTIVES IN ECOLOGY: PAST, PRESENT, AND FUTURE, SNOWBIRD, UTAH, USA, JULY 29-AUGUST 2, 1990.
BULL ECOL SOC AM 71 (2 SUPPL.). 1990. 143.

Keywords/ABSTRACT *ORGYIA-PSEUDOTSUGATA* *NUCLEAR* *POLYHEDROSIS* VIRUS LARVA HOST MOVEMENT BEHAVIOR SPATIAL RATE OF SPREAD POPULATION DYNAMICS MATHEMATICS.

FOSSIEZ-F. BELLONCIK-S. ARELLA-M.
NUCLEOTIDE SEQUENCE OF THE POLYHEDRIN GENE OF EUXOA-SCANDENS CYTOPLASMIC *POLYHEDROSIS* VIRUS ESCPV.
VIROLOGY 169 (2). 1989. 462-465.
VIROLOGY.
ABSTRACT
The double-stranded RNA genome of Euxoa scandens cytoplasmic *polyhedrosis* virus (EsCPV) was reversely transcribed to the double-stranded DNA and cloned into pIB130. The complete nucleotide sequence of cloned genome segment 10, which encodes the virus polyhedrin polypeptide, was determined. The EsCPV polyhedrin gene consists of 881 bp and possesses an open reading frame that codes for a polypeptide of 269 amino acids (MW 30.1K), consistent with an apparent MW of 30K determined by SDS-PAGE for purified polyhedrin. The sequence is identical to that reported for the amino terminus of polyhedrin from the CPV of *Orgyia* *pseudotsugata;* however, no amino acid or nucleotide sequence homology was found between the EsCPV polyhedrin and that from Bomyx mori CPV (BmCPV) or several *nuclear* *polyhedrosis* viruses. The hydrophilic profiles and predicted secondary structures of both EsCPV and BmCPV polyhedrin show some similarities, mainly in the amino half of the polypeptides. These data should be helpful in identifying the domains responsible for the polyhedrin crystallizing properties.

Keywords/ *ORGYIA-PSEUDOTSUGATA* CYTOPLASMIC *POLYHEDROSIS* VIRUS BOMBYX-MORI CYTOPLASMIC *POLYHEDROSIS* VIRUS *NUCLEAR* *POLYHEDROSIS* VIRUS HOMOLOGY SECONDARY STRUCTURE MOLECULAR SEQUENCE DATA AMINO ACID SEQUENCE EMBL-J04338 GENBANK-J04338.

GETZENDANER-C-W.
DOUGLAS-FIR TUSSOCK MOTH VIRUS TESTS. PASE IV: STUDY OF METHODS AND MATERIALS FOR EVALUATING VIRUS SPRAY DEPOSITS.
PROG. REP. ON FILE USDA AGRIC. RES. SERV., ENTOMOL. RES. DIV. FOREST GROVE, OREG. 1966. 19P

GLASER-R-W; CHAPMAN-J-W.
THE NATURE OF THE POLYHEDRAL BODIES FOUND IN INSECTS
BIOL. BULL 30(5). 1916. 367-391
BIOLOGY BULLETIN

GOMBART-A-F. BLISSARD-G-W. ROHRMANN-G-F.
CHARACTERIZATION OF THE GENETIC ORGANIZATION OF THE HIND-III M REGION OF THE MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS OF *ORGYIA-PSEUDOTSUGATA* REVEALS MAJOR DIFFERENCES AMONG BACULOVIRUSES.
J GEN VIROL 70 (7). 1989. 1815-1828.
JOURNAL OF GENERAL VIROLOGY.
ABSTRACT

A region including the 4 kb HindIII M fragment of the multicapsid *nuclear* *polyhedrosis* virus (MNPV) of *Orgyia* *pseudotsugata* (OpMNPV) genome was sequenced, transcriptionally mapped, and compared to the homologous region in the MNPV of Autographa californica (AcMNPV). Five open reading frames (ORFs) oriented in the same direction were identified and were found to be expressed at late times post-infection. The mRNAs from the five ORFs were found to coterminate at a single site downstream of ORF 5. The conserved late gene promoter/mRNA start site sequence (GATAAG) was present upstream of all the ORFs, did not appear to be the major site of mRNA initiation for two of the ORFs as determined by primer extension analysis. These data indicated that use of this signal for transcriptional initiation may vary between different ORFs. The predicted amino acid sequences for the five ORFs of AcMNPV and OpMNPV were compared and amino acid homologies of 26 to 72% were observed. The comparison revealed a number of major differences in the genomes of the two viruses. A putative transposable element of 634 nucleotides was found to be inserted into the previously reported AcMNPV ORF 1 sequence. In addition, it was found that a region corresponding to the 4 kb HindIII K/EcoRI S/hr5 region of AcMNPV was not present in the OpMNPV genome.

Keywords/AUTOGRAPHA-CALIFORNICA *NUCLEAR* *POLYHEDROSIS* VIRUS OPEN READING FRAME EARLY PROMOTER REGION MOLECULAR SEQUENCE DATA NUCLEOTIDE SEQUENCE AMINO ACID SEQUENCE EMBL-D00366 GENBANK-D00366 DDBJ-D00366 SEQUENCE COMPARISON.

GOMBART-A-F. PEARSON-M-N. ROHRMANN-G-F. BEAUDREAU-G-S.
A BACULOVIRUS POLYHEDRAL ENVELOPE-ASSOCIATED PROTEIN GENETIC LOCATION NUCLEOTIDE SEQUENCE AND IMMUNOCYTOCHEMICAL CHARACTERIZATION.
VIROLOGY 169 (1). 1989. 182-193.
VIROLOGY.
ABSTRACT
Using a polyclonal mouse antiserum produced against purified virions of the multicapsid *nuclear* *polyhedrosis* virus of *Orgyia* *pseudotsugata* (OpMNPV), two immunoreactive .lambda.gtll clones were identified which contained nonoverlapping insert DNAs which mapped to a single open reading frame (ORF) in the HindIII-M fragment. Analysis of nucleotide sequence data indicates that this ORF encodes a protein with a MW of 32.4 kDa. A trpE-p32 gene fusion containing the entire p32 ORF was constructed, and the fusion protein was purified and used to immunize rabbits. Western blot analysis and immunofluorescence studies using the anti-TrpE-p32 antiserum detected a polyhedra-derived virus (PDV)-associated protein of 32 kDa at 24 hr postinfection (hr p.i.). The protein was observed in the cytoplasm and nucleus at 24 hr p.i. and became concentrated in the cytoplasm late in infection. Western blot analysis and immunofluorescent microscopy of polyhedra solubilized under various conditions indicated that p32 is associated with the polyhedral envelope. The predicted amino acid sequence for p32 showed 58% amino acid identity with the predicted amino acid sequence for an ORF (ORF 3) in a similar region of the genome of the MNPV of Autographa californica (AcMNPV). The solubility properties of the p32 protein and reciprocal immunoblotting experiments indicate the OpMNPV p32 gene encodes a protein which is homologous to the polyhedral envelope-associated phosphoprotein of AcMNPV, pp34, recently reported by M.A. Whitt and J. S. Manning (1988) Virology 163, 33-42.

Keywords/*ORGYIA-PSEUDOTSUGATA* *NUCLEAR* *POLYHEDROSIS* VIRUS AUTOGRAPHA-CALIFORNICA *NUCLEAR* *POLYHEDROSIS* VIRUS P32 GENE ENVELOPE-ASSOCIATED PHOSPHOPROTEIN PP34 HOMOLOGY MOLECULAR SEQUENCE DATA AMINO ACID SEQUENCE.

GROSS-C. ROHRMANN-G-F.
ANALYSIS OF THE ROLE OF 5' PROMOTER ELEMENTS AND 3' FLANKING SEQUENCES ON THE EXPRESSION OF A BACULOVIRUS POLYHEDRON ENVELOPE PROTEIN GENE.
VIROLOGY 192 (1). 1993. 273-281.
VIROLOGY.

ABSTRACT
The polyhedron envelope protein gene of the *Orgyia* *pseudotsugata* multinucleocapsid *nuclear* *polyhedrosis* virus (OpMNPV) is the third in a series of five open reading frames (ORFs 1-5) oriented in the same direction. Individual mRNAs initiate at conserved late gene promoter/mRNA start site (A/GTAAG) sequences located upstream of each ORF and the mRNAs coterminate after the fifth ORF. To examine the influence of transcription from upstream promoter elements and the presence of an extensive 3' flanking sequence on the expression of the polyhedron envelope protein gene, the region was cloned into a phagemid vector and a BamHI site was inserted downstream of the ATG by site-directed mutagenesis and used for the insertion of a chloramphenicol acetyl transferase (CAT) reporter gene. A set of clones were constructed in which individual or combinations of the late promoter elements from ORFs 1, 2, and 3 were destroyed by site-directed mutagenesis. These plasmid constructs were transfected into Lymantria dispar cells infected with OpMNPV and cell extracts were assayed for CAT activity. Inactivation of the late promoter element immediately 5' of the polyhedron envelope protein gene led to a 96% decrease in CAT expression. Destruction of the ORF 2 late promoter element, or both the ORF 1 and ORF 2 late promoter elements, or deletion of the entire region containing ORFs 1 and 2 resulted in a 17 to 35% increase in CAT expression. In contrast, inactivation of the ORF 1 promoter alone resulted in no increase in CAT expression. Deletions of the 3' flanking sequences of the polyhedron envelope protein gene caused major reductions in both CAT activity and steady-state levels of CAT mRNA.

Keywords/LYMANTRIA-DISPAR *ORGYIA-PSEUDOTSUGATA* MULTINUCLEOCAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS GENE REGULATION.

GROSS-C-H. ROHRMANN-G-F.
MAPPING UNPROCESSED EPITOPES USING DELETION MUTAGENESIS OF GENE FUSIONS.
BIOTECHNIQUES 8 (2). 1990. 196-198, 200-202.
BIOTECHNIQUES.
ABSTRACT
To locate the antigenic determinant recognized by a monoclonal antibody directed against a baculovirus capsid protein, a series of overlapping deletions of a fusion protein were immunologically screened with the monoclonal antibody. The immunoreactive fusion protein was derived from a restriction fragment which contained a large portion of a baculovirus capsid protein open reading frame fused in-frame with a truncated trpE gene in a bacterial (pATH3) expression system. To map the epitope, nested sets of 5' and 3' deletion mutants were generated. Mutants were characterized by the DNA insert size or by the size of the expressed fusion protein. Selected N- and C-termini truncated fusion proteins were Western blotted and incubated with the monoclonal antibody to indentify mutants which retained the epitope. Plasmid DNA from mutants which flank the 5' and 3' junction of the antigenic determinants were sequenced to determine the epitope junction. By screening forty 3' deletions and sixty-four 5' deletions, the antigenic determinant was localized to a region of seven amino acids.

Keywords/*ORGYIA-PSEUDOTSUGATA* *NUCLEAR* *POLYHEDROSIS* VIRUS ESCHERICHIA-COLI TRP-E FUSION VIRAL CAPSID PROTEIN MONOCLONAL ANTIBODY BIOTECHNOLOGY MOLECULAR SEQUENCE DATA AMINO ACID SEQUENCE NUCLEOTIDE SEQUENCE.

GROSS C H; RUSSELL R L Q; ROHRMANN G F
ORGYIA PSEUDOTSUGATA BACULOVIRUS P10 AND POLYHEDRON ENVELOPE PROTEIN GENES: ANALYSIS OF THEIR RELATIVE EXPRESSION LEVELS AND ROLE IN POLYHEDRON STRUCTURE
JOURNAL OF GENERAL VIROLOGY 75 (5). 1994. 1115-1123.
Full Journal Title: Journal of General Virology
Language: ENGLISH
ABSTRACT

To investigate the regulation of p10 and polyhedron envelope protein (PEP) gene expression and their role in polyhedron development, Orgyia pseudotsugata multi-nucleocapsid nuclear polyhedrosis viruses lacking these genes were constructed. Recombinant viruses were produced, in which the p10 gene, the PEP gene or both genes were disrupted with the beta-glucuronidase (GUS) or beta-galactosidase (lacZ) genes. GUS activity under the control of the PEP protein promoter was observed later in infection and its maximal expression was less than 10% the level for p10 promoter-GUS constructs. Tissues from O. pseudotsugata larvae infected with these recombinants were examined by electron microscopy. Cells from insects infected with the p10-viruses lacked p10-associated fibrillar structures, but fragments of polyhedron envelope-like structures were observed on the surface of some polyhedra. Immunogold labelling of cells infected with the p10-GUS+ virus with an antibody directed against PEP showed that the PEP was concentrated at the surface of polyhedra. Although polyhedra produced by p10 and PEP gene deletion mutants demonstrated what appeared to be a polyhedron envelope by transmission electron microscopy, scanning electron microscopy showed that they had irregular, pitted surfaces that were different from wild-type polyhedra. These data suggested that both p10 and PEP are important for the proper formation of the periphery of polyhedra.

Keywords/ RESEARCH ARTICLE; ORGYIA PSEUDOTSUGATA MULTINUCLEOCAPSID NUCLEAR POLYHEDROSIS VIRUS; BETA-GLUCURONIDASE; BETA-GALACTOSIDASE; ENVELOPE-LIKE STRUCTURE; ELECTRON MICROSCOPY

GROSS-C-H. WOLGAMOT-G-M. RUSSELL-R-L-Q. PEARSON-M-N. ROHRMANN-G-F.
A 37-KILODALTON GLYCOPROTEIN FROM A BACULOVIRUS OF *ORGYIA-PSEUDOTSUGATA* IS LOCALIZED TO CYTOPLASMIC INCLUSION BODIES.
J VIROL 67 (1). 1993. 469-475.
JOURNAL OF VIROLOGY.
ABSTRACT
The gene encoding a 37-kDa glycoprotein (gp37) of *Orgyia* *pseudotsugata* multinucleocapsid *nuclear* *polyhedrosis* virus (OpMNPV) was located and sequenced. gp37 of OpMNP was found to have 62 and 37% amino acid sequence identity with gp37 of Autographa californica multinucleocapsid *polyhedrosis* virus (AcMNPV) and with a protein reported to be a component of occlusion bodies from Choristoneura biennis entomopoxvirus, respectively. The mRNA start site of the OpMNPY gp378 gene was mapped within a late promoter sequence (TTAAG). A TrpE fusion protein containing 55% of the OpMNPV gp37 gene amino acid sequence was used to generate a monospecific antiserum. Western immunoblot analysis of OpMNPV-infected lymantria dispar cells detected gp37 beginning at 24 h postinfection. Immunoelectron microscopy indicated that the protein is concentrated in cytoplasmic inclusion bodies late in infection. In contrast to gp37 of AcMNPV which was present in the matrix of occlusion bodies, OmPNPV gp37 was not observed in this location. Neither OpMNPV nor AcMNPV gp37 was associated with the polyhedron envelope.

Keywords/LYMANTRIA-DISPAR *ORGYIA-PSEUDOTSUGATA* MULTINUCLEOCAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS AUTOGRAPHA-CALIFORNICA MULTINUCLEOCAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS CHORISTONEURA BIENNIS ENTOMOPOXVIRUS MOLECULAR SEQUENCE DATA NUCLEOTIDE SEQUENCE AMINO ACID SEQUENCE IDENTITY EMBL-D13306 GENBANK-D13306 DDBJ-D13306 TRANSCRIPT START SITE GENE MAPPING.

GROSS-C-H. WOLGAMOT-G-M. RUSSELL-R-L-Q. PEARSON-M-N. ROHRMANN-G-F.
A BACULOVIRUS ENCODED 16-KDA GLYCOPROTEIN LOCALIZES NEAR THE *NUCLEAR* MEMBRANE OF INFECTED CELLS.
VIROLOGY 192 (1). 1993. 386-390.
VIROLOGY.
ABSTRACT
An open reading frame (ORF 2) located upstream of the polyhedron envelope protein gene of *Orgyia* *pseudotsugata* multicapsid *nuclear* *polyhedrosis* virus (OpMNPV) was cloned in frame into a trpE expression vector. The fusion protein produced by this construct was used for the production of a

monospecific antiserum. Western blot analysis of OpMNPV-infected Lymantria dispar cells detected a 16-kDa protein at 24 hr postinfection. The 16-kDa protein was determined to be N-glycosylated by tunicamycin treatment of infected cells. Immunofluorescence microscopy localized the 16-kDa protein to foci of intense cytoplasmic staining near the *nuclear* membrane. Immunoelectron microscopy indicated that the 16-kDa protein is associated with lamellar-like structures peripheral to the *nuclear* membrane and with envelopes of virus that have budded into the cytoplasm. The 16-kDa protein was not associated with extracellular budded or polyhedron-derived virions.

Keywords/LYMANTRIA-DISPAR *ORGYIA-PSEUDOTSUGATA* MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS LAMELLAR-LIKE STRUCTURE BUDDED VIRUS ENVELOPE.

HU-Y. FAN-Q. ZHANG-C. HOU-Y. LI-G. LU-S. HE-L. JIN-Q.
LOCATION AND CLONING OF POLYHEDRIN GENE OF ANTHERAEA-PERNYI *NUCLEAR* *POLYHEDROSIS* VIRUS.
CHIN J VIROL 3 (2). 1987. 156-162.
BINGDU XUEBAO.
Language/Chinese.
ABSTRACT
The polyhedrin gene was identified to be located on the BamHI D and E fragments of ApNPV genome DNA by Southern hybridization with OpNPV polyhedrin gene fragment as a probe. Subsequently, the BamHI D and E fragments were cloned into plasma AT153. A portion containing the polyhedrin gene of ApNPV was mapped and the 5' and 3' ends of the gene were determined by the terminal hybridization procedure. Furthermore, a small region containing 222 bp coding for ApNPV polyhedrin gene was sequenced. The result indicated that the nucleotide sequences of ApNPV polyhedrin gene is homologous with AcNPV, BmNPV and OpNPV by 75.5%, 84% and 80% respectively.

Keywords/AUTOGRAPHA-CALIFORNICA *NUCLEAR* *POLYHEDROSIS* VIRUS *ORGYIA-PSEUDOTSUGATA* *NUCLEAR* *POLYHEDROSIS* VIRUS BOMBYX-MORI *NUCLEAR* *POLYHEDROSIS* VIRUS NUCLEOTIDE SEQUENCE HOMOLOGY.

HU-Z-H. LIU-M-F. JIN-F. WANG-Z-X. LIU-X-Y. LI-M-J. LIANG-B-F. XIE-T-E.
NUCLEOTIDE SEQUENCE OF THE BUZURA SUPPRESSARIA SINGLE NUCLEOCAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS POLYHEDRIN GENE.
J GEN VIROL 74 (8). 1993. 1617-1620.
JOURNAL OF GENERAL VIROLOGY.
ABSTRACT
A portion of the genome of the Buzura suppressaria (Lepidoptera) single nucleocapsid *nuclear* *polyhedrosis* virus (BsSNPV) containing the polyhedrin gene was sequenced. An open reading frame of 738 nucleotides encoded a protein of 246 amino acids and represented the polyhedrin gene. A conserved TAAG motif, associated with transcriptional start sites in other polyhedrin genes, was identified 51 nucleotides upstream of the BsSNPV polyhedrin gene. A putative polyadenylation signal, AATAAA, was found immediately downstream of the polypeptide termination codon. Comparison of the amino acid sequence of BsSNPV polyhedrin with other NPV polyhedrins and granulosis virus granulins showed that the BsSNPV polyhedrin was most closely related to the polyhedrin of Orgvia *pseudotsugata* (Lepidoptera) SNPV and most distantly related to the polyhedrin of Neodiprion sertifer (Hymenoptera) SNPV.

Keywords/*ORGYIA-PSEUDOTSUGATA* *NUCLEAR* *POLYHEDROSIS* VIRUS NEODIPRION SERTIFER *NUCLEAR* *POLYHEDROSIS* VIRUS GRANULOSIS VIRUS MOLECULAR SEQUENCE DATA AMINO ACID SEQUENCE GENBANK-X70844 GRANULIN HOMOLOGY CONSERVED TRANSCRIPTIONAL START SITE POLYADENYLATION SIGNAL.

HU-Y. QI-F. ZHANG-C. HOU-Y. LI-G.
SEQUENCING OF NONCODING REGION AT 5' END OF POLYHEDRIN GENE FROM ANTHERAEA-PERNYI *NUCLEAR* *POLYHEDROSIS* VIRUS APNPV.
CHIN J VIROL 4 (I). 1988. 89-90.
BINGDU XUEBAO.
Language/Chinese
ABSTRACT
The noncoding region at the 5' end of the polyhedrin gene of Antheraea pernyi *Nuclear* *Polyhedrosis* Virus (ApNPV) was sequenced. The nucleotide sequence was compared with the corresponding region of the polyhedrin gene of Autographa californica NPV (ApNPV), Bombyx mori NPV (BmNPV) and *Orgyia* *pseudotsugata* NPV (OpNPV). The result showed that the region -1 to -54 bp upstream from the start codon ATG is highly conserved, the homology between them is 72% to 85%. There is a consensus sequence CCTATAA at -3 to -9 (from -4 to -9 for ApNPV) upstream from ATG. The nucleotides around the ATG is variable. AcNPV has a TAATG sequence, and all the genes of the four NPVs contain adenine at -3 position. An extra sequence AGATAATTA was found in AcNPV at -78 to -86 bp. Our sequence data indicate that the conserved sequence at 5' end might be important for gene expression. This information may be required for the design and construction of baculovirus expression vector.

Keywords/AUTOGRAPHA-CALIFORNICA *NUCLEAR* *POLYHEDROSIS* VIRUS BOMBYX-MORI *NUCLEAR* *POLYHEDROSIS* VIRUS *ORGYIA-PSEUDOTSUGATA* *NUCLEAR* *POLYHEDROSIS* VIRUS BACULOVIRUS VECTOR.

HUGHES-K-M.
SOME INTERACTIONS OF 2 BACULOVIRUSES OF THE *DOUGLAS-FIR* *TUSSOCK* *MOTH* *ORGYIA-PSEUDOTSUGATA* LEPIDOPTERA LYMANTRIIDAE.
CAN ENTOMOL I I1 (4). 1979. 521-524.
CANADIAN ENTOMOLOGIST.
ABSTRACT
Two *nuclear* *polyhedrosis* viruses were fed to larvae of the *Douglas-fir* *tussock* *moth,* O. *pseudotsugata.* Mixtures of the 2 viruses in varying proportions and separate doses of the 2 with a varying time interval between were administered. Larvae dying of *polyhedrosis* were examined to proportions of the 2 viruses found in the bodies of the insects. The multicapsid virus (BV) showed a tendency to predominate over the unicapsid virus (SV), particularly in massive doses. In small doses, SV appeared in mixed infections even when the proportion of SV in the infective does was small. When BV was administered 24 h in advance of SV, the development of SV was inhibited completely. At shorter intervals of time between doses, mixed infections occurred.

Keywords/MULTI CAPSID VIRUS UNI CAPSID VIRUS.

HUGHES-K-M.
THE MACROMOLECULAR LATTICES OF POLYHEDRA
J. INVERTEBR. PATHOL 31(2). 1978. 217-224
JOURNAL OF INVERTEBRATE PATHOLOGY

HUGHES-K-M.
NOTES ON THE *NUCLEAR* *POLYHEDROSIS* VIRUSES OF *TUSSOCK* *MOTHS* OF THE GENUS *ORGYIA* LEPIDOPTERA.
CAN ENTOMOL I08 (5). 1976. 479-484.
CANADIAN ENTOMOLOGIST.
ABSTRACT

Three western species of *tussock* *moths* of the genus *Orgyia* O. *pseudotsugata,* O. antiqua, O. vetusta are all susceptible to infection by the same 2 *nuclear* *polyhedrosis* viruses. An eastern species of *Orgyia* O. leucostigma is also affected by these viruses. In the western states USA, the natural occurrence of the 2 viruses appears to be limited to definite geographic areas. Infectivity of the viruses for hosts outside the genus *Orgyia* is not known. One report of such cross-infectivity could not be substantiated. Bodies which appear to be composed of viral materials but which are not normal virus particles are sometimes found occluded in polyhedra.

Keywords/*ORGYIA-PSEUDOTSUGATA* *ORGYIA-ANTIQUA* *ORGYIA-VETUSTA* *ORGYIA-LEUCOSTIGMA* USA.

HUGHES-K-M.
FINE STRUCTURE AND DEVELOPMENT OF TWO POLYHEDROSIS VIRUSES
J. INVERTEBR. PATHOL. 19(2). 1972. 198-207
JOURNAL OF INVERTEBRATE PATHOLOGY

HUGHES-K-M.
A DEMONSTRATION OF THE NATURE OF POLYHEDRA USING ALKALINE SOLUTIONS
J. BACTERIOL 59(2). 1950. 189-195
JOURNAL OF BACTERIOLOGY

HUGHES-K-M. ADDISON-R-B.
2 *NUCLEAR* *POLYHEDROSIS* VIRUSES OF THE *DOUGLAS* *FIR* *TUSSOCK* *MOTH.*
J INVERTEBR PATHOL 16 (2). 1970. 196-204.
JOURNAL OF INVERTEBRATE PATHOLOGY.

Keywords/*HEMEROCAMPA-PSEUDOTSUGATA.*

JEWELL-J-E. MILLER-L-K.
DNA SEQUENCE HOMOLOGY RELATIONSHIPS AMONG 6 LEPIDOPTERAN *NUCLEAR* *POLYHEDROSIS* VIRUSES.
J GEN VIROL 48 (1). 1980. 161-176.
JOURNAL OF GENERAL VIROLOGY.
ABSTRACT
The DNA sequence homology relationships among 6 lepidopteran *nuclear* *polyhedrosis* viruses (NPV) were explored by hybridization of 32P-labeled NPV DNA to Southern blots of restriction endonuclease-digested NPV DNA. The Autographa californica NPV (AcMNPV) shows extensive DNA sequence homology throughout the entire genome with the Rachiplusia ou NPV (RoMNPV). The *Orgyia* *pseudotsugata* NPV (OpMNPV) and the Porthetria dispar NPV (PdMNPV) share homologous regions, equivalent to 1% of the DNA genome, with AcMNPV and RoMNPV. This homology is localized in 2 regions on the AcMNPV physical map although other regions are also weakly homologous. About 1% of the DNA of OpMNPV and PdMNPV show sequence homology with each other; the homology is primarily localized in 2-4 regions of the genomes. Heliothis zea NPV and Trichoplusia ni NPV share less than 0.2% sequence homology with the MNPV and share less than 0.2% sequence homology with each other.

Keywords/AUTOGRAPHA-CALIFORNICA RACHIPLUSIA-OU *ORGYIA-PSEUDOTSUGATA* PORTHETRIA-DISPAR HELIOTHIS-ZEA TRICHOPLUSIA-NI.

KAUPP W J; EBLING P M

EFFECT OF MECHANICAL PROCESSING AND LONG-TERM STORAGE ON BIOLOGICAL ACTIVITY OF VIRTUSS
CANADIAN ENTOMOLOGIST 125 (5). 1993. 975-977.
Full Journal Title: Canadian Entomologist
Language: ENGLISH

Keywords/ RESEARCH ARTICLE; BIOLOGICAL CONTROL; NUCLEAR POLYHEDROSIS VIRUS, DOUGLAS FIR TUSSOCK MOTH

KNELL-J-D. SUMMERS-M-D. SMITH-G-E.
SEROLOGICAL ANALYSIS OF 17 BACULOVIRUSES FROM SUBGROUPS A AND B USING PROTEIN BLOT IMMUNOASSAY.
VIROLOGY 125 (2). 1983. 381-392.
VIROLOGY.
ABSTRACT
The protein blot radioimmunoassay technique was used to evaluate the immunoreactivity of antisera made against sodium dodecyl sulfate (SDS)-disrupted baculovirus structural proteins. Eight antisera (6 for NPV and 2 for GV) were tested against 11 *nuclear* *polyhedrosis* (NPV) and 6 granulosis viruses (GV). Homologous reactions revealed that SDS-disrupted baculovirus antigens elicited antibodies which reacted with several of the virus proteins. Heterologous reactions of each viral antiserum were determined with a total of 17 baculoviruses. Using these data it was possible to detect a number of shared antigenic determinants which revealed some specific serological relationships among some of the 17 viruses tested. The MNPV showing distinct serological relatedness included those of Autographa californica, Rachiplusia ou, Anticarsia gemmatalis, Choristoneura fumiferana and *Orgyia* *pseudotsugata.* Heliothis armigera MNPV and H. zea SNPV shared cross-reacting antigenic determinants as did Trichoplusia ni SNPV, Pseudoplusia includens SNPV and H. zea SNPV. The GV of T. ni, H. armiger and Spodoptera frugiperda were also serologically related. Also reactions were detected which indicated the presence of common antigenic determinants among different baculovirus subgroups in addition to those originally detected in an earlier study. Because of the large number of structural proteins in baculoviruses and the lack of information concerning their structural or functional roles in the virus group specific antigenic determinants could not be identified. Protein blot radioimmunoassay allows specific identification of baculoviruses and the number and MW of homologous and heterologous proteins sharing antigenic determinants.

Keywords/AUTOGRAPHA-CALIFORNICA RACHIPLUSIA-OU ANTICARSIA-GEMMATALIS CHORISTONEURA-FUMIFERANA *ORGYIA-PSEUDOTSUGATA* HELIOTHIS-ARMIGERA HELIOTHIS-ZEA TRICHOPLUSIA-NI PSEUDOPLUSIA-INCLUDENS *NUCLEAR* *POLYHEDROSIS* VIRUS GRANULOSIS VIRUS STRUCTURAL PROTEINS.

KNOX,D-A.
TESTS OF CERTAIN INSECT VIRUSES ON COLONIES OF HONEYBEES
J. INVERTEBR. PATHOL 16(1). 1970. 152
JOURNAL OF INVERTEBRATE PATHOLOGY

KOGAN P H; BLISSARD G W
A BACULOVIRUS GP64 EARLY PROMOTER IS ACTIVATED BY HOST TRANSCRIPTION FACTOR BINDING TO CACGTG AND GATA ELEMENTS
JOURNAL OF VIROLOGY 68 (2). 1994. 813-822.
Full Journal Title: Journal of Virology
Language: ENGLISH
ABSTRACT

The early promoter of the Orgyia pseudotsugata multicapsid nuclear polyhedrosis virus gp64 gene is active when transfected into several insect cell lines and does not require viral gene products for transcription in uninfected cells. Because previous studies have shown that the gp64 early promoter is activated above basal levels in uninfected cells, host transcription factors are likely to play a role in gp64 activation at early times postinfection. By using nuclear extracts from uninfected Sf9 cells for electrophoretic mobility shift analysis of gp64 regulatory regions, host nuclear proteins were shown to bind specifically to the upstream regulatory region of the gp64 early promoter. Host factor binding was mapped to a 24-bp sequence centered approximately 35 bp upstream of the TATA box. Two consensus eukaryotic transcription factor-binding site motifs, CATA and CACGTG, were identified within the 24-bp sequence. Competition assays using oligonucleotides containing either a GATA or a CACGTG motif and similar oligonucleotides with point mutations in these sites showed that each site is required for binding host transcription factors. To investigate the functional significance of host factor binding to GATA and CACGTG motifs, constructs containing point mutations in these motifs were examined in transient expression assays. Mutations in either or both GATA and CACGTG sites decreased reporter activity in transient expression assays, suggesting that binding of host transcription factors to these motifs is important in transcriptional regulation of the gp64 early promoter.

Keywords/ RESEARCH ARTICLE; SF9 CELLS; ORGYIA PSEUDOTSUGATA NUCLEAR POLYHEDROSIS VIRUS; NUCLEOTIDE SEQUENCE; MOLECULAR SEQUENCE DATA; GENE REGULATION

LEISY-D. NESSON-M. PEARSON-M. ROHRMANN-G. BEAUDREAU-G.
LOCATION AND NUCLEOTIDE SEQUENCE OF THE *ORGYIA-PSEUDOTSUGATA* SINGLE NUCLEOCAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS POLYHEDRIN GENE.
J GEN VIROL 67 (6). 1986. 1073-1080.
JOURNAL OF GENERAL VIROLOGY.
ABSTRACT
A restriction endonuclease map was determined for the *Orgyia* *pseudotsugata* single nucleocapsid *nuclear* *polyhedrosis* virus (SNPV) genome. The order of the fragments generated by the enzymes Bg/II, BamHI and XbaI was analyzed using double digestion of the total genome and digestion of isolated restriction fragments. The location of the polyhedrin gene was then determined using a cloned polyhedrin gene from the O. *pseudotsugata* multiple nucleocapsid NPV (MNPV) as a hybridization probe. A fragment containing this gene was cloned, mapped, subcloned and the nucleotide sequence of a 1.3 kb fragment was determined which contained the entire polyhedrin reading frame and some flanking sequences. This gene demonstrated 76% nucleotide sequence homology and 87% amino acid sequence homology to the Autographa californica MNPV polyhedrin sequence. A probable regulatory element was identified which is common to the 5' flanking region of all hypertranscribed late genes (polyhedrin and 10K proteins) which have been examined in baculoviruses.

Keywords/AUTOGRAPHA-CALIFORNICA MULTIPLE NUCLEOCAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS NUCLEOTIDE SEQUENCE HOMOLOGY AMINO-ACID SEQUENCE HOMOLOGY.

LEISY-D. ROHRMANN-G. BEAUDREAU-G.
THE NUCLEOTIDE SEQUENCE OF THE POLYHEDRIN GENE REGION FROM THE MULTICAPSID BACULOVIRUS OF *ORGYIA-PSEUDOTSUGATA.*
VIROLOGY 153 (2). 1986. 280-288.
VIROLOGY.
ABSTRACT
The nucleotide sequence was determined of a 1.6-kb restriction fragment containing the polyhedrin gene of the multicapsid *nuclear* *polyhedrosis* virus of *Orgyia* *pseudotsugata* (OpMNPV). In addition, both the 5' and 3' termini of the polyhedrin mRNA were located in the flanking sequences using S1 mapping

procedures. 5' Leader, 3' flanking, and open reading frame sequences of 50-52, 145-167, and 735 nucleotides. A potential 5' regulatory sequence which included the mRNA initiation site was identified and an open reading frame upstream of the polyhedrin gene was located. In addition to the polyhedrin mRNA, two major transcripts upstream of the polyhedrin gene were identified by transcriptional mapping.

Keywords/MESSENGER RNA OPEN READING FRAME.

LEISY-D-J. ROHRMANN-G-F. NESSON-M. BEAUDREAU-G-S.
NUCLEOTIDE SEQUENCING AND TRANSCRIPTIONAL MAPPING OF THE *ORGYIA-PSEUDOTSUGATA* MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS P-10 GENE.
VIROLOGY 153 (2). 1986. 157-167.
VIROLOGY.
ABSTRACT
A 32P-labeled clone DNA fragment (AcMNPV HindIII-Q) containing one of the repeated sequences and a portion of the p10 gene from Autographa californica multicapsid *nuclear* *polyhedrosis* virus (AcMNPV) was used to probe Southern blots containing restriction endonuclease digests of *Orgyia* *pseudotsugata* multicapsid *nuclear* *polyhedrosis* virus (OpMNPV) DNA. A single 3.6-kb fragment, OpMNPV HindIII-Q, was hybridized. The OpMNPV HindIII-Q fragment was cloned into pUC-18, mapped with restriction endonucleases, and reprobed with the AcMNPV HindIII-Q fragment. A small region of ca 700 bp, near the left end of the cloned fragment, was cross-hybridized. DNA sequencing in this region revealed an open reading frame of 279 bp which shares detectable homology with the p10 gene of AcMNPV. The sequences downstream from the p10 gene in both viruses also contain long open reading frames which share homology. Northern blot analysis of RNA from OpMNPV infected O. leucostigma cells was used to define the temporal and spatial organization of transcripts from this region. S1 analysis of both termini of the major p10 mRNA indicates nontranslated regions of 52-53 bases at the 5' end and 175 bases at the 3' end. The 5'-mRNA start site was located within a 12-nucleotide sequence which is conserved in all late hyperexpressed baculovirus genes.

Keywords/ NUCLEOTIDE SEQUENCE CONSERVATION.

LONGWORTH-J-F. KALMAKOFF-J.
AN ECOLOGICAL APPROACH TO THE USE OF INSECT PATHOGENS FOR PEST CONTROL.
LOUTIT, MARGARET W. AND JOHN A. R. MILES (ED.). PROCEEDINGS IN LIFE SCIENCES. MICROBIAL ECOLOGY. FIRST INTERNATIONAL SYMPOSIUM. 1977. XXII+452P. ILLUS. SPRINGER-VERLAG: NEW YORK, N.Y., USA; BERLIN, WEST GERMANY. ISBN 0-387-08974-8; ISBN 3-540-08974-8. 1978. 269-271.

Keywords/HELIOTHIS-ZEA NOSEMA-LOCUSTAE ORYCTES-RHINOCEROS WISEANA-SP *DOUGLAS-FIR* *TUSSOCK* *MOTH* JACK PINE SAWFLY *NUCLEAR* *POLYHEDROSIS* VIRUS BACULOVIRUS PINE FOREST NEW-ZEALAND USA SAMOA CANADA.

LU-A. CARSTENS-E-B.
NUCLEOTIDE SEQUENCE AND TRANSCRIPTIONAL ANALYSIS OF THE P80 GENE OF AUTOGRAPHA-CALIFORNICA *NUCLEAR* *POLYHEDROSIS* VIRUS A HOMOLOGUE OF THE *ORGYIA-PSEUDOTSUGATA* *NUCLEAR* *POLYHEDROSIS* VIRUS CAPSID-ASSOCIATED GENE.
VIROLOGY 190 (1). 1992. 201-209.
VIROLOGY.
ABSTRACT
The 67.2- to 68.5-m.u. region of Autographa californica *nuclear* *polyhedrosis* virus was sequenced. A large open reading frame (ORF) was identified in the clockwise direction on the circular genome map which

could potentially encode an 80-kDa polypeptide. Analysis of the predicted amino acid sequence of this ORF indicated that it was a homologue of the p87 capsid-associated gene of *Orgyia* *pseudotsugata* MNPV with an overall amino acid similarity of 34.3%. A late transcript of 2.1 kb was mapped to this open reading frame. An antisense 3.1-kb transcript partially overlapped the 5' end of the 2.1-kb RNA. Anti-extracellular virus sera reacted with a fusion protein consisting of a portion of the AcMNPV p80 gene fused to the bacterial trpE gene product, suggesting that the AcMNPV p80 gene product was also a component of the virus capsid.

Keywords/VIRUS CAPSID COMPONENT OPEN READING FRAME PREDICTED AMINO ACID SEQUENCE SIMILARITY MOLECULAR SEQUENCE DATA GENE MAPPING ANTIBODY GENBANK-M94914.

MAEDA-S. KAMITA-S-G. KATAOKA-H.
THE BASIC DNA-BINDING PROTEIN OF BOMBYX-MORI *NUCLEAR* *POLYHEDROSIS* VIRUS THE EXISTENCE OF AN ADDITIONAL ARGININE REPEAT.
VIROLOGY 180 (2). 1991. 807-810.
VIROLOGY.
ABSTRACT
The basic DNA-binding protein of the Bombyx mori *nuclear* *polyhedrosis* virus (BmNPV) was purified by HPLC and a sequence of 45 amino acids from the N-terminus was determined. There were no detectable modifications such as N-terminal blockage, glycosylation, or phosphorylation. The amino acid sequence showed high homology to the predicted amino acid sequences of the basic proteins of Autographa californica NPV (AcNPV) and *Orgyia* *pseudotsugata* NPV (OpNPV) (90 and 76%, respectively), however, the BmNPV basic protein possessed an additional sequence of 10 amino acids. A DNA fragment encoding the basic protein was identified in a BmNPV DNA library by screening for possible DNA sequences coding for the basic protein's amino acid sequence. The nucleotide sequence of the basic protein of BmNPV was more similar to that of AcNPV (97%) than to that of OpNPV (62%). Homology plot analysis of the nucleotide sequence indicates that the BmNPV basic protein internal repeat evolved very recently.

Keywords/AUTOGRAPHA-CALIFORNICA *NUCLEAR* *POLYHEDROSIS* VIRUS *ORGYIA-PSEUDOTSUGATA* *NUCLEAR* *POLYHEDROSIS* VIRUS AMINO ACID SEQUENCE NUCLEOTIDE SEQUENCE MOLECULAR SEQUENCE DATA HOMOLOGY EVOLUTION.

MAKSYMIUK-B; BOVING-P-A; ORCHARD-R-D; WINTERFELD-R-G.
FORESTS TESTS TO DEVELOP AN OPERATIONAL METHOD TO CONTROL THE DOUGLAS-FIR TUSSOCK MOTH WITH A POLYHEDROSIS VIRUS
USDA FOR. SERV. PAC. NORTHWEST FOR. AND RANGE EXP. STN. CORVALLIS, ORE. PROG. REP. 1968. 33P.

MAKSYMIUK-B-P; BOVING-R-D; ORCHARD-R-D; WINTERFELD-R-G.
BIOLOGICAL EVALUATION OF HELICOPTER SPRAY EQUIPMENT FOR APPLYING POLYHEDROSIS VIRUS TO CONTROL THE DOUGLAS-FIR TUSSOCK MOTH
USDA FOR. SERV. PAC. NORTHWEST FOR. AND RANGE EXP. STN., CORVALLIS, OREG. PROG. REP. 1968. 38P.

MARTIGNONI-M-E.
A RAPID METHOD OF THE IDENTIFICATION OF NUCLEOPOLYHEDRON TYPES
J. INVERTEBR. PATHOL. 19(2). 1972. 281-283
JOURNAL OF INVERTEBRATE PATHOLOGY

MARTIGNONI-M-E. IWAI-P-J.
LABORATORY EVALUATION OF NEW UV ABSORBERS FOR PROTECTION OF *DOUGLAS-FIR* *TUSSOCK* *MOTH* LEPIDOPTERA LYMANTRIIDAE BACULOVIRUS.
J ECON ENTOMOL 78 (4). 1985. 982-987.
JOURNAL OF ECONOMIC ENTOMOLOGY.
ABSTRACT
In 1975, the Forest Service (USDA) recommended use of the adjuvant Shade as a UV absorber in spray mixes of *TM* *BioControl-I,* the *nuclear* *polyhedrosis* virus (NPV) or *Orgyia* *pseudotsugata* (McDunnough). Because Shade is no longer available commercially, we evaluated suitable substitutes compatible with the NPV of O. *pseudotsugata.* Materials tested included two lignosulfonates, a disulfobenzophenone, and two fluorescent whitening agents. Shade was also tested as a reference standard. The materials were evaluated by exposing virus-absorber mixtures to UV radiation from high-intensity mercury sun lamps. We used a new technique that permitted individual handling of samples, on sterile disposable Teflon pads, through various steps of the test procedure. Two of the materials, Tinopal DCS (a stilbene fluorescent whitening agent) and Raymix powder (a lignosulfonate),protected O. pseudotosugata NPV against UV radiation equally or better than did Shade. Both UV absorbers are soluble in cold water, with pH near neutrality.

Keywords/*ORGYIA-PSEUDOTSUGATA* *NUCLEAR* *POLYHEDROSIS* VIRUS FORMULATION MICROBIAL CONTROL STILBENE FLUORESCENT WHITENING AGENT LIGNOSULFONATE DISULFOBENZOPHENONE.

MARTIGNONI-M-E. IWAI-P-J.
PROPAGATION OF MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS OF *ORGYIA-PSEUDOTSUGATA* IN LARVAE OF TRICHOPLUSIA-NI.
J INVERTEBR PATHOL 47 (I). 1986. 32-41.
JOURNAL OF INVERTEBRATE PATHOLOGY.
ABSTRACT
The multicapsid *nuclear* *polyhedrosis* virus (OpMNPV) of *Orgyia* *pseudotsugata* (Lepidoptera: Lymantriidae) was adapted by serial passage to a substitute host, Trichoplusia ni (Lepidoptera: Noctuidae). During the first five virus passages, we found only localized lesions in fat body and epidermis of infected T. ni larvae. Disseminated lesions were observed in the sixth passage. Systemic fat body, tracheal, and epidermal lesions typical of *nuclear* *polyhedrosis* appeared in the seventh passage. The adapted virus (OpMNPV-Tn) maintained the high virulence of OpMNPV for larvae of the natural host, O. *pseudotsugata.* After one reverse passage in O. *pseudotsugata,* the virulence of OpMNPV-Tn for the natural host increased to tenfold that of technical-grade OpMNPV. The reverse-passage virus had the highest activity in O. *pseudotsugata* thus far observed in our laboratory. The DNA profile of OpMNPV by five restriction endonucleases was maintained upon passage in T. ni. Because T. ni has many advantages over the natural host for propagation of OpMNPV, we performed several small-scale virus production trials and computed average virus yields. Presently, the average yield of OpMNPV per T. ni larvae is lower than expected for larvae of this size. The substitute host, however, offers a continuous and abundant supply of nondiapausing eggs and has a very brief life cycle. For large-scale production, these advantages outweigh the reduced virus yield.

Keywords/VIRAL YIELD HOST SPECIFICITY VIRULENCE MICROBIAL CONTROL.

MARTIGNONI-M-E. IWAI-P-J.
ACTIVITY STANDARDIZATION OF TECHNICAL PREPARATIONS OF *DOUGLAS-FIR* *TUSSOCK* *MOTH* MACULOVIRUS.
J ECON ENTOMOL 71 (3). 1978 473-476.
JOURNAL OF ECONOMIC ENTOMOLOGY.
ABSTRACT

Polyhedron counts are the most commonly used measure of the potency of technical *nucleopolyhedrosis* virus preparations. The actual potency of such preparations, however, can be determined only by bioassay. If the bioassay is standardized, it provides a frame of reference for comparisons among microbial products and among results of field applications. An activity standardization procedure based on the stability of the response of an inbred strain of *Orgyia* *pseudotsugata* (McDunnough) is described. The response of strain CL-1 is the reference standard currently accepted by the U.S. Environmental Protection Agency and by the U.S. Forest Service for activity titrations of industrial preparations of *Douglas* *fir* *tussock* *moth* Baculovirus. Tests covering a 2 yr span and 3 generations of GL-I larvae show that the procedure is highly reproducible.

Keywords/*ORGYIA-PSEUDOTSUGATA* *NUCLEOPOLYHEDROSIS* VIRUS.

MARTIGNONI-M-E; IWAI-P-J.
THERMAL INACTIVATION CHARACTERISTICS OF TWO STRAINS OF NUCLEOPOLYHEDROSIS VIRUS (BACULOVIRUS SUBGROUPa) PATHOGENIC FOR ORGYIA PSEUDOTSUGATA
J. INVERTEBR. PATHOL 30(2). 1977. 255-262
JOURNAL OF INVERTEBRATE PATHOLOGY

MARTIGNONI-M-E. IWAI-P-J.
THERMAL INACTIVATION CHARACTERISTICS OF 2 STRAINS OF *NUCLEOPOLYHEDROSIS* VIRUS BACULOVIRUS SUBGROUP A PATHOGENIC FOR *ORGYIA-PSEUDOTSUGATA.*
J INVERTEBR PATHOL 30 (2). 1977. 255-262.
JOURNAL OF INVERTEBRATE PATHOLOGY.
ABSTRACT
Two *nucleopolyhedrosis* viruses of the *Douglas-fir* *tussock* *moth,* O. *pseudotsugata,* one with a single nucleocapsid per envelope (SV) and one with multiple nucleocapsids per envelope (BV), are inactivated by a 1st-order reaction at 55.degree. and 60.degree. C. BV is more thermostable. At both test temperatures, it has a lower inactivation rate than SV. BV is more virulent with respect to acute course of the disease and severity of the histological lesions. The greater thermostability of BV and the acute course of the disease caused by this pathogen support the choice of BV as the virus most suitable for industrial production and field use as a viral insecticide.

Keywords/HISTOLOGY BIOLOGICAL CONTROL.

MARTIGNONI-M-E; IWAI-P-J; BREILLATT-J-P.
HETEROGENEOUS BUOYANT DENSITY IN BATCHES OF VIRAL NUCLEOPOLYHEDRA
J. INVERTEBR. PATHOL 18(2). 219-226
JOURNAL OF INVERTEBRATE PATHOLOGY

MARTIGNONI-M-E. IWAI-P-J. ROHRMANN-G-F.
SERUM NEUTRALIZATION OF *NUCLEOPOLYHEDROSIS* VIRUSES BACULOVIRUS SUBGROUP A PATHOGENIC FOR *ORGYIA-PSEUDOTSUGATA.*
J INVERTEBR PATHOL 36 (I). 1980. 12-20.
JOURNAL OF INVERTEBRATE PATHOLOGY.
ABSTRACT
The preparation of antisera to intracellular nonoccluded virions and an in vivo neutralization test procedure (constant serum and virus in dilutions) are described. Results of homologous neutralization tests showed that rabbit antisera to 2 multicapsid viruses pathogenic for O. *pseudotsugata* had higher neutralization indices than antiserum to a unicapsid Baculovirus from O. *pseudotsugata.* Based on reciprocal tests, the 3 viruses are antigenically distinguishable. Blood serum of rats which were exposed by inhalation to 25 projected acre

doses of a technical-grade Baculovirus preparation demonstrated no viral neutralizing activity. Since this neutralization test does not require availability of susceptible cell lines and is sensitive and accurate, it could be used in quality control programs and in field monitoring of Baculovirus strains.

Keywords/RABBIT RAT BLOOD SERUM QUALITY CONTROL.

MARTIGNONI-M-E. STELZER-M-J. IWAI-P-J.
BACULOVIRUS OF AUTOGRAPHA-CALIFORNICA LEPIDOPTERA NOCTUIDAE A CANDIDATE BIOLOGICAL CONTROL AGENT FOR *DOUGLAS-FIR* *TUSSOCK* *MOTH* *ORGYIA-PSEUDOTSUGATA* LEPIDOPTERA LYMANTRIIDAE.
J ECON ENTOMOL 75 (6). 1982. 1120-1124.
JOURNAL OF ECONOMIC ENTOMOLOGY.
ABSTRACT
A strain of Baculovirus *(nucleopolyhedrosis* virus) recently isolated from Autographa californica (Speyer) (AcMNPV) was virulent for the *Douglas-fir* *tussock* *moth,* *Orgyia* *pseudotsugata* (McDunnough). Based on polyhedron-to-bioactivity ratios, the new AcMNPV strain has nearly 1/3 the activity of a Baculovirus (OpMNPV) isolated from O. *pseudotsugata.* OpMNPV is registered in the USA (with the name *TM* *BioControl-1)* as a biological insecticide for control of the *Douglas-fir* *tussock* *moth* in *Douglas-fir* and true *fir* forests of the western states. Sprayed at equal levels of activity with an aerial-application simulator, AcMNPV equals OmMNPV in efficacy. An analysis of survival time patterns shows that the disease caused by AcMNPV in O. *pseudotsugata* has a more acute course than that caused by OpMNPV. Compared with OpMNPV, AcMNPV has several advantages as a microbial insecticide. AcMNPV can be produced in a relatively simple system, costs less than OpMNPV produced in O. *pseudotsugata,* and has a wider host range than OpMNPV. The evidence strongly favors consideration of AcMNPV as a viral agent for *Douglas-fir* *tussock* *moth* control.

Keywords/*DOUGLAS-FIR* *NUCLEOPOLYHEDROSIS* VIRUS MICROBIAL INSECTICIDE.

MILLER-L-K. DAWES-K-P.
RESTRICTION ENDO NUCLEASE ANALYSIS FOR THE IDENTIFICATION OF BACULOVIRUS PESTICIDES.
APPL ENVIRON MICROBIOL 35 (2). 1978 411-421.
APPLIED AND ENVIRONMENTAL MICROBIOLOGY.
ABSTRACT
Gel electrophoresis of deoxyribonucleic acid (DNA) fragments generated by digesting the DNA genomes of *nuclear* *polyhedrosis* viruses (NPV) with restriction endonucleases provides DNA fragment patterns that may be used to identify different viruses of this group. Characteristic fragment patterns were obtained for 3 NPV, which are important as biological pesticides (Autographa californica NPV, *Orgyia* *pseudotsugata* NPV and Heliothis zea NPV). The DNA fragment patterns of the A. californica NPV genome did not change with passage through the alternate insect host, Trichoplusia ni. Heterogeneity in one preparation of O. *pseudotsugata* NPV was observed. The identification procedure is direct and precise. Applications of this procedure include quality control of commercial preparations of viral pesticides and screening for genetic alterations in the viruses.

Keywords/AUTOGRAPHA-CALIFORNICA *ORGYIA-PSEUDOTSUGATA* HELIOTHIS-ZEA TRICHOPLUSIA-NI DNA DIGESTION GENETIC ALTERATIONS.

MORRIS-O-N.
MICROORGANISMS ISOLATED FROM FOREST INSECTS OF BRITISH-COLUMBIA CANADA.
J ENTOMOL SOC B C 80. 1983. 29-36.
JOURNAL OF THE ENTOMOLOGICAL SOCIETY OF BRITISH COLUMBIA.

ABSTRACT
Pathogenic and non-pathogenic microorganisms including fungi, bacteria, viruses, miscrosporidia and nematodes were isolated from about 14,000 specimens representing 108 pest species of insects collected from British Columbia forests between 1949 and 1969. Entomophthora sp. and Beauveria sp. were the most widely distributed fungal organisms isolated, occurring in 14 and 29 insect species, respectively. *Nuclear* *polyhedrosis* and granulosis viruses were isolated from 53 spp. microsporida from 26, pathogenic bacteria from 12 and nematodes from 2 spp. Bacillus thuringiensis var. canadensis was isolated from Lambdina fiscellaria lugubrosa (Hlst.) and a Neophasia sp. The largest numbers of species of microorganisms were found in Melanolophia imitata (Wlk.), Malacosoma disstria Hbn., M. pluviale (Dyar), L. lugubrosa, Acleris variana (Fern.), Hyphantria cunea Dru., Choristoneura fumiferana (Clem), *Orgyia* *pseudotsugata* (McD) and Neophasia menapia Feld.

Keywords/ENTOMOPHTHORA-SP BEAUVERIA-SP BACILLUS-THURINGIENSIS-VAR-CANADENSIS LAMBDINA-FISCELLARIA-LUGUBROSA NEOPHASIA-SP MELANOLOPHIA-IMITATA MALACOSOMA-DISSTRIA MALACOSOMA-PLUVIALE ACLERIS-VARIANA HYPHANTRIA-CUNEA CHORISTONEURA-FUMIFERANA *ORGYIA-PSEUDOTSUGATA* NEOPHASIA-MENAPIA *NUCLEAR* *POLYHEDROSIS* VIRUS GRANULOSIS VIRUS NEMATODA MICROS(ORIDA MICROBIAL CONTROL.

MORRIS-O-N.
METABOLIC CHANGES IN DISEASES INSECTS PART 4 RADIO AUTOGRAPHIC STUDIES ON PROTEIN CHANGES IN *NUCLEAR* *POLYHEDROSIS* DENSONUCLEOSIS AND TIPULA IRIDESCENT VIRUS INFECTIONS.
J INVERTEBR PATHOL 18 (2). 1971. 191-206.
JOURNAL OF INVERTEBRATE PATHOLOGY.

Keywords/LEPIDOPTERA HYMENOPTERA LAMBDINA-FISCELLARIA-LUGUBROSA CARIPETA-DIVISATA *ORGYIA-PSEUDOTSUGATA.*

MORSE-M-A. MARRIOTT-A-C. NUTTALL-P-A.
THE GLYCOPROTEIN OF THOGOTO VIRUS A TICK-BORNE ORTHOMYXO-LIKE VIRUS IS RELATED TO THE BACULOVIRUS GLYCOPROTEIN GP64.
VIROLOGY 186 (2). 1992. 640-646.
VIROLOGY.
ABSTRACT
Thogoto (THO) virus is a tick-transmitted virus which shares morphological and biochemical characteristics with members of the Orthomyxoviridae. The genome of Thogoto virus comprises six segments of single-stranded, negative sense RNA. The complete nucleotide sequence of the fourth largest RNA segment of THO virus has been determined from cDNA analyses. This RNA segment is 1574 nt long and has a coding capacity for a glycoprotein of 512 amino acids with a predicted molecular weight of 57,550 Da. The sequence of this protein has extensive homology with the putative envelope protein of Dhori (DHO) virus, the only oher recorded thick-borne orthomyxo-like virus, but not with the envelope glycoproteins of the influenza viruses. A search of the translation of the available nucleotide database has produced evidence for a relationship between the glycorproteins of THO and DHO viruses and the gp64 glycoprotein of two DNA-containing insect baculoviruses, Autographa california *nuclear* *polyhedrosis* virus and *Orgyia* *pseudotsugata* nulcear *polyhedrosis* virus. The baculovirus gp64 protein is a membrane protein implicated in endocytotic fusion events during infection. A multiple alignment between these four glycoproteins gave significance scores of > 28 standard deviations, indicating that the homologies between them are highly significant. The distribution of cysteine residues is conserved between all four proteins which also have similar hydropathy profiles, suggestive of a type I membrane protein topology.

Keywords/*ORGYIA-PSEUDOTSUGATA* *NUCLEAR* *POLYHEDROSIS* VIRUS DHORI VIRUS AUTOGRAPHA-CALIFORNICA *NUCLEAR* *POLYHEDROSIS* VIRUS COMPLEMENTARY DNA INFLUENZA VIRUS ENDOCYTOTIC FUSION TYPE I MEMBRANE PROTEIN TOPOLOGY NUCLEOTIDE SEQUENCE MOLECULAR SEQUENCE DATA AMINO ACID SEQUENCE GENBANK-M77280.

MULLER-R. PEARSON-M-N. RUSSELL-R-L-Q. ROHRMANN-G-F.
A CAPSID-ASSOCIATED PROTEIN OF THE MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS OF *ORGYIA-PSEUDOTSUGATA* GENETIC LOCATION SEQUENCE TRANSCRIPTIONAL MAPPING AND IMMUNOCYTOCHEMICAL CHARACTERIZATION.
VIROLOGY 176 (1). 1990. 133-144.
VIROLOGY.
ABSTRACT
Two .lambda.gt11 clones containing overlapping DNA inserts encoding portions of a structural protein gene from *Orgyia* *pseudotsugata* multicapsid *nuclear* *polyhedrosis* virus (OpMNPV) were identified by their immunoreactivity with polyclonal antisera produced against purified polyhedra-derived virus. Sequence analysis of a 3.6-kb region of the baculovirus genome (map units 69.1-71.6) from which the .lambda.gt11 inserts originated revealed an open reading frame of 1872 nt (624 amino acids) encoding a predicted protein of 70.6 kDa. Northern blot, primer extension, and 3' S1 analysis of this ORF indicated that an mRNA of approximately 2100 nt was transcribed from this gene. The mRNA appears to initiate from a late promoter/mRNa start site consensus sequence GTAAG and is expressed at late times postinfection. A gene fusion containing the C-terminal 368 amino acids of the gene was constructed using a bacterial trpE expression vector. Rabbit antiserum made against the purified fusion protein reacted with a protein of 87 kDa on Western blots of infected cell extracts at 24 hr p.i. and thereafter. The p87 protein was shown to be a component of both budded and polyhedra-derived virus and purified capsids. Immunofluorescence analysis indicated that p87 is expressed late in infection and concentrated in infected cell nuclei.

Keywords/LYMANTRIA-DISPAR IPLB-LD-652Y CELLS EMBL-D00514 GENBANK-D00514 MOLECULAR SEQUENCE DATA AMINO ACID SEQUENCE NUCLEOTIDE SEQUENCE.

NEISESS-J-A. HUBBARD-H-B.
APPLICATION OF MICROBIAL INSECTICIDES ON FORESTS.
MISC PUBL ENTOMOL SOC AM 10 (5). 1978. 27-43.
MISCELLANEOUS PUBLICATIONS OF THE ENTOMOLOGICAL SOCIETY OF AMERICA.

Keywords/BACILLUS-THURINGIENSIS LYMANTRIA-DISPAR *ORGYIA-PSEUDOTSUGATA* *NUCLEAR* *POLYHEDROSIS* VIRUS.

OTVOS-I-S. CUNNINGHAM-J-C. ALFARO-R-I.
AERIAL APPLICATION OF *NUCLEAR* *POLYHEDROSIS* VIRUS AGAINST *DOUGLAS-FIR* *TUSSOCK* *MOTH* *ORGYIA-PSEUDOTSUGATA* MCDUNNOUGH LEPIDOPTERA LYMANTRIIDAE II. IMPACT 1 AND 2 YEARS AFTER APPLICATION.
CAN ENTOMOL 119 (7-8). 1987. 707-716.
CANADIAN ENTOMOLOGIST.
ABSTRACT
Following aerial application of a *Douglas-fir* *tussock* *moth,* *Orgyia* *pseudotsugata* (McDunnough), *nuclear* *polyhedrosis* virus (NPV) product called Virtuss on four plots in 1982, observations were made to determine the impact of these treatments in 1983 and 1984. Treated plots as well as buffer zones between and adjoining the treated plots, and three of the four check plots established in 1982, were monitored. The NPV appeared to have spread from the treated plots to adjoining areas in 1982, effectively reducing the *Douglas-fir* *tussock* *moth* population. This observation suggests that a strategy of spraying alternate swaths of

Douglas-fir *tussock* *moth* infested stands with this viral insecticide may effectively initiate an epizootic that would control the population at a reduced cost. A naturally occurring NPV epizootic decimated the *Douglas-fir* *tussock* *moth* population in the three check plots in I983, but severe tree mortality occurred in two of these plots with 60 and 62% of sample trees dead in I984. Light tree mortality was noted in 1984 in two of the four treated plots with 4 and 7% of sample trees killed. It is concluded that the virus treatments in I982 were successful in preventing tree mortality.

Keywords/VIRTUSS POPULATION REDUCTION TREE MORTALITY.

OTVOS-I-S. CUNNINGHAM-J-C. FRISKIE-L-M.
AERIAL APPLICATION OF *NUCLEAR* *POLYHEDROSIS* VIRUS AGAINST *DOUGLAS-FIR* *TUSSOCK* *MOTH* *ORGYIA-PSEUDOTSUGATA* MCDUNNOUGH LEPIDOPTERA LYMANTRIIDAE I. IMPACT IN THE YEAR OF APPLICATION.
CAN ENTOMOL 119 (7-8). I987. 697-706.
CANADIAN ENTOMOLOGIST.
ABSTRACT
Four 10-ha plots located in Kamloops Forest District, British Columbia Canada, containing *Douglas-fir* trees infested with *Douglas-fir* *tussock* *moth* were aerially sprayed with *nuclear* *polyhedrosis* virus (Virtuss) in 1982 when most larvae were in the first instar. A dosage of 2.5 .times. 101I polyhedral inclusion bodies (PIB) per hectare was applied in an emulsifiable oil tank mix to one plot and the same dosage in an aqueous tank mix containing molasses was applied to a second plot. The remaining two plots were treated with dosages of 8.3 .times. I010 and I.6 .times. 1010 PIB per hectare, respectively, in the oil mix. The treatments were applied with a fixed-wing aircraft fitted with boom and nozzle equipment and calibrated to deliver 9.4 L/ha. A further four plots were selected as checks. Population reduction at 6 weeks post-spray (calculated using a modified Abbott's formula) was 65% in the plot receiving the lowest dosage and from 87 to 95% in the remaining three plots. Incidence of virus infection, determined microscopically, peaked at 5-6 weeks post-spray with 85-I00% of the larvae scored as positive. Levels of naturally occurring virus remained low in the check plots. Adult emergence from the pupae collected in the treated plots ranged from 4 to 19% and from 28 to 43% in the check plots. Reduction in egg-mass density attributed to the treatments was 97% in one plot, 99% in two others, and not determined for the fourth. A virus dosage of 8.3 .times. 1010 PIB per hectare, which is one-third of the previously recommended dosage, is adequate, and either tank mix is acceptable.

Keywords/LARVAE EMERGENCE EGG-MASS DENSITY POPULATION REDUCTION BRITISH COLUMBIA CANADA.

OTVOS-I-S. SHEPHERD-R-F.
INTEGRATION OF EARLY VIRUS TREATMENT WITH A PHEROMONE DETECTION SYSTEM TO CONTROL *DOUGLAS-FIR* *TUSSOCK* *MOTH* *ORGYIA-PSEUDOTSUGATA* LEPIDOPTERA LYMANTRIIDAE POPULATIONS AT PRE-OUTBREAK LEVELS.
XVIII INTERNATIONAL CONGRESS OF ENTOMOLOGY, VANCOUVER, BRITISH COLUMBIA, CANADA, I988.
FOR ECOL MANAGE 39 (I-4). 1991. I43-I52.
FOREST ECOLOGY AND MANAGEMENT.

Keywords/PSEUDOTSUGA-MENZIESII ABIES-CONCOLOR *NUCLEAR* *POLYHEDROSIS* VIRUS.

PASSARELLI A L; MILLER L K
IDENTIFICATION OF GENES ENCODING LATE EXPRESSION FACTORS LOCATED BETWEEN 56.0 AND 65.4 MAP UNITS OF THE AUTOGRAPHA CALIFORNICA NUCLEAR POLYHEDROSIS VIRUS GENOME

VIROLOGY 197 (2). 1993. 704-714.
Full Journal Title: Virology
Language: ENGLISH
ABSTRACT
Using a previously developed method that allows the identification of Autographa californica nuclear polyhedrosis virus (AcMNPV) genes which stimulate transient expression from a late and a very late viral promoter (Passarelli and Miller, J. Virol., 67, 2149-2158 (1993)), we have identified three genes between 56.0 and 65.4 map units of the AcMNPV genome involved in expression from a late and a very late promoter but not from an early viral promoter. One gene, p143, was previously shown to be essential for viral DNA replication and shares sequence motifs with DNA helicases (Lu and Carstens, Virology, 181, 336-347 (1991)). The second gene, previously sequenced and originally referred to as open reading frame 6 (herein renamed late expression factor-5 (lef-5)), was located just downstream of the 6.9 kilodalton core protein gene, p6.9. The third gene, late expression factor-4 (lef-4), was defined and sequenced. The lef-4 gene was located immediately upstream of, and in opposite orientation to, the major capsid protein gene, vp39. The position and direction of lef-4 appeared to be conserved in the Orgyia pseudotsugata and Lymantria dispar nuclear polyhedrosis viruses. The gene product of lef-4, LEF-4, is predicted to be an acidic polypeptide (pI 4.91) of 464 amino acids in length with a molecular mass of 53,913 daltons.

KEYWORDS/ RESEARCH ARTICLE; ORGYIA PSEUDOTSUGATA NUCLEAR POLYHEDROSIS VIRUS; LYMANTRIA DISPAR NUCLEAR POLYHEDROSIS VIRUS; DNA HELICASE-LIKE P143 GENE; LEF-5 GENE; LEF-4 GENE; MOLECULAR SEQUENCE DATA; NUCLEOTIDE SEQUENCE; AMINO ACID SEQUENCE; GENBANK-L20217; EMBL-L20217; LATE PROMOTER; VERY LATE PROMOTER; CONSERVED GENE ORGANIZATION

PEARSON M N; BJORNSON R M; AHRENS C; ROHRMANN G F
IDENTIFICATION AND CHARACTERIZATION OF A PUTATIVE ORIGIN OF DNA REPLICATION IN THE GENOME OF A BACULOVIRUS PATHOGENIC FOR ORGYIA PSEUDOTSUGATA
VIROLOGY 197 (2). 1993. 715-725.
Full Journal Title: Virology
Language: ENGLISH
ABSTRACT
A four-kilobase (kb) region (HindIII-N, map units 7.0-11.3) of the Orgyia pseudotsugata multinucleocapsid nuclear polyhedrosis virus (OpMNPV) genome was found to contain sequences that conferred upon plasmids the ability to undergo infection-dependent replication. The plasmid DNA appeared to be replicated to form high molecular weight multimers. Plasmids with deletions of up to 1.8 kb from either end of the HindIII-N region were replication competent. However, a discrete sequence, contained within the region bracketed by the deletions, capable of specifying replication was not identified. No evidence for sequence homology was found between the OpMNPV HindIII-N region and regions elsewhere in the OpMNPV genome or to putative Autographa californica MNPV (AcMNPV) replication origins. Origin-dependent plasmid replication was shown to require the presence of the OpMNPV DNA polymerase gene. The OpMNPV origin replicated poorly in AcMNPV-infected Spodoptera frugiperda cells and, conversely, a putative AcMNPV origin (hr2) replicated at low levels in OpMNPV-infected Lymantria dispar cells.

Keywords/ RESEARCH ARTICLE; SPODOPTERA FRUGIPERDA; LYMANTRIA DISPAR; AUTOGRAPHA CALIFORNICA NUCLEAR POLYHEDROSIS VIRUS; ORGYIA PSEUDOTSUGATA NUCLEAR POLYHEDROSIS VIRUS; MOLECULAR SEQUENCE DATA; NUCLEOTIDE SEQUENCE; GENBANK-D17353; EMBL-D17353; DDBJ-D17353; DNA POLYMERASE GENE REQUIREMENT

PEARSON-M-N. RUSSELL-R-L-Q. ROHRMANN-G-F. BEAUDREAU-G-S.
P39 A MAJOR BACULOVIRUS STRUCTURAL PROTEIN IMMUNOCYTOCHEMICAL CHARACTERIZATION AND GENETIC LOCATION.

VIROLOGY 167 (2). 1988. 407-413.
VIROLOGY.
ABSTRACT
A series of monoclonal antibodies was produced against proteins from polyhedra-derived virions of the multicapsid *nuclear* *polyhedrosis* virus of *Orgyia* *pseudotsugata* (OpMNPV). Two of these antibodies (214 and 236) reacted with a protein of 39 kDa on Western blots of electrophoretically separated OpMNPV virion proteins derived from both budded and polyhedra-derived virions. This protein appears to be a major component of both BV and PDV. One of the p39 antibodies was used to characterized p39 synthesis in infected Lymantria dispar cells by using Western blots and immunofluorescent staining. The p39 protein was detected by immunofluorescence microscopy at 24 h postinfection. By 48 hr, p39 was detected primarily in cell nuclei with little or no detectable staining of the cytoplasm. The two MAbs were used to identy three immunoreactive clones from a .lambda. gt11 expression library of OpMNPV DNA. By hybridization of insert DNA from three .lambda. gt11 clones to blots of restriction digests of OpMNPV genomic DNA, the location of the 39-kDa gene was mappedon the OpMNPV genome. Using the .lambda. gt11 insert DNAs and the monoclonal antibodies, the p39 genes and proteins of OpMNPV and Autographa californica NPV (AcMNPV) were shown to be closely related in size, DNA sequence, and antigenicity. One of the p39 monoclonal antibodies cross-reacted with a host cell protein associated with the condensed chromosomes present during mitosis.

Keywords/*ORGYIA-PSEUDOTSUGATA* *NUCLEAR* *POLYHEDROSIS* VIRUS AUTOGRAPHA-CALIFORNICA *NUCLEAR* *POLYHEDROSIS* VIRUS LYMANTRIA-DISPAR CELLS.

PERLMAN-F; PRESS-E; GOOGINS-J-A; MALLEY-A. POAREA-H.
TUSSOCKOSIS: REACTIONS TO DOUGLAS-FIR TUSSOCK MOTH
ANN ALLERGY 36(5). 1976. 302-307

QUANT-R-L. PEARSON-M-N. ROHRMANN-G-F. BEAUDREAU-G-S.
PRODUCTION OF POLYHEDRIN MONOCLONAL ANTIBODIES FOR DISTINGUISHING 2 *ORGYIA-PSEUDOTSUGATA* BACULOVIRUSES.
APPL ENVIRON MICROBIOL 48 (4). 1984. 732-736.
APPLIED AND ENVIRONMENTAL MICROBIOLOGY.
ABSTRACT
Monoclonal antibodies were produced to polyhedrins from O. *pseudotsugata* multicapsid *nuclear* *polyhedrosis* virus (OpMNPV) and single-capsid *nuclear* *polyhedrosis* virus (OpSNPV). Although the polyhedrins are closely related, antibodies were selected which allowed differentiation between the 2 viruses. In an indirect enzyme-linked immunosorbent assay, purified OpMNPV and OpSNPV polyhedrins could be detected by specific monoclonal antibodies at concentrations as low as 2 and 5 ng/ml, respectively. The antibodies were also capable of identifying their homologous polyhedrin in extracts of infected insects. These antibodies would be useful for monitoring production of the viral insecticide, *TM* *Biocontrol-1,* which by license must contain only OpMNPV, and to confirm that insect mortality after aerial spraying with this insecticide is attributable to OpMNPV infection.

Keywords/INDIRECT ENZYME-LINKED IMMUNOSORBENT ASSAY ELISA INSECT INFECTION VIRAL INSECTICIDE AERIAL SPRAYING MICROBIAL CONTROL.

QUANT-RUSSELL-R-L. PEARSON-M-N. ROHRMANN-G-F. BEAUDREAU-G-S.
CHARACTERIZATION OF BACULOVIRUS P10 SYNTHESIS USING MONOCLONAL ANTIBODIES.
VIROLOGY 160 (1). 1987. 9-19.
ABSTRACT
A series of monoclonal antibodies were produced against virion proteins of the multicapsid *nuclear* *polyhedrosis* virus of *Orgyia* *pseudotsugata* (OpMNPV). Four of these antibodies reacted with a

protein of 14 kd on Western blots of electrophoretically separated OpMNPV virion proteins. These antibodies were used to identify immunoreactive clones from a .lambda. gt11 expression library of OpMNPV DNA. By hybridization of insert DNA from the .lambda. gt11 clones to blots of digests of OpMNPV genomic DNA, and by sequencing the ends of the .lambda. g11 inserts, these clones were shown to contain a portion of the p10 gene. The regions containing epitopes recognized by the four monoclonal antibodies were located using fusion proteins made from selected portions of the p10 reading frame in a trpE vector. One of the p10 antibodies was used to characterize p10 synthesis in infected Lymantria dispar cells by using Western blots and immunofluorescent staining. The p10 protein was detected with immunofluorescent microscopy at 14 hr postinfection and by 20 hr it formed intensely staining cytoplasmic structures. On Western blots of infected cells, two forms of p10 (of about 14 and 15 kd) were observed. One of the p10 monoclonal antibodies showed a strong cross-reaction with cytoskeletal structures in uninfected insect cells and rat fibroblasts.

Keywords/*ORGYIA-PSEUDOTSUGATA* *NUCLEAR* *POLYHEDROSIS* VIRUS LYMANTRIA-DISPAR CELLS RAT FIBROBLASTS CYTOSKELETAL CROSS-REACTIVITY.

ROGOFF-M-HL
PRODUCTION RESPONSIBILITIES: PRIVATE SECTOR AND COMMERICAL PRODUCER OF VIRUS.
IN BACULOVIRUSES FOR INSECT PEST CONTROL: SAFETY CONSIDERATIONS P. 159-161.
M. SUMMERS, R. ENGLER, L. A. FALCON, AND P. V. VAIL, EDS. AM SOC. MICROBIOL.
WASHINGTON, D.C.

ROHRMANN-G-F.
CHARACTERIZATION OF N POLYHEDRIN OF 2 BACULOVIRUS STRAINS PATHOGENIC FOR *ORGYIA-PSEUDOTSUGATA.*
BIOCHEMISTRY 16 (8). 1977. 1631-1634.
BIOCHEMISTRY.
ABSTRACT
N-polyhedrin of inclusion bodies of 2 *nucleopolyhedrosis* viruses of O. *pseudotsugata* was characterized. Alkali-dissolved N-polyhedrin from both virus strains was of similar size and consisted of a 12S molecule of 209,000 daltons. Eight subunits of .apprx. 26,000 daltons were found to form the 12S molecules. N-polyhedrin from both viruses showed 2 main antigens by immunodiffusion. The subunits appear to possess 1 antigen and, upon formation of the 12S molecule, a new antigen is created. Both the subunit and 12S antigens from the 2 virus strains were antigenically related. The 12S molecule of both viruses also appears to possess a minor antigen unique to each virus.

ROHRMANN-G-F. BAILEY-T-J. BEAUDREAU-G-S. BECKER-R-R.
AMINO TERMINAL AMINO-ACID SEQUENCES OF POLYHEDRINS FROM 3 OCCLUDED VIRUSES OF *ORGYIA-PSEUDOTSUGATA.*
ABSTR ANNU MEET AM SOC MICROBIOL (79). 1979. 269.
ABSTRACTS OF THE ANNUAL MEETING OF THE AMERICAN SOCIETY FOR MICROBIOLOGY.

Keywords/ABSTRACT BOMBYX-MORI BACULOVIRUS *NUCLEO* *POLYHEDROSIS* BUNDLE VIRUS *NUCLEOPOLYHEDROSIS* SINGLE ROD VIRUS CYTOPLASMIC *POLYHEDROSIS* VIRUS.

ROHRMANN-G-F. BAILEY-T-J. BECKER-R-R. BEAUDREAU-G-S.
COMPARISON OF THE STRUCTURE OF C POLYHEDRINS AND N POLYHEDRINS FROM 2 OCCLUDED VIRUSES PATHOGENIC FOR *ORGYIA-PSEUDOTSUGATA.*
J VIROL 34 (2). 1980. 360-365.
JOURNAL OF VIROLOGY.
ABSTRACT

C- and N-polyhedrins from a cytoplasmic *polyhedrosis* virus (a double-stranded RNA virus) and a *nuclear* *polyhedrosis* virus (a DNA virus), respectively, of O. *pseudotsugata* were compared. Although both polyhedrins appear to stabilize their respective virions and have similar MW, they differed in amino acid composition, tryptic peptide elution profiles from a cation-exchange resin and N-terminal amino acid sequence and showed no antigenic relatedness. These proteins probably originated independently of each other.

Keywords/CYTOPLASMIC *POLYHEDROSIS* VIRUS *NUCLEAR* *POLYHEDROSIS* VIRUS.

ROHRMANN-G-F. BAILEY-T-J. BRIMHALL-B. BECKER-R-R. BEAUDREAU-G.
TRYPTIC PEPTIDE ANALYSIS AND AMINO TERMINAL AMINO-ACID SEQUENCES OF POLYHEDRINS OF 2 BACULOVIRUSES FROM *ORGYIA-PSEUDOTSUGATA.*
PROC NATL ACAD SCI U S A 76 (10). 1979. 4976-4980.
PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA.
ABSTRACT
Comparative analysis of the tryptic peptides and terminal amino acid sequence was made on polyhedrins from 2 genetically different baculoviruses that are naturally pathogenic for the same insect host Comparison of the tryptic peptides of the *nucleopolyhedrosis* bundle virus and *nucleopolyhedrosis* bundle virus and *nucleopolyhedrosis* single-rod virus of O. *pseudotsugata* by cation-exchange resins indicated that the proteins have a closely related amino acid sequence. The NH2-terminal amino amino acid sequence. The NH2-terminal amino acid sequence of polyhedrins from the 2 viruses differed in only 4 out of 34 amino acids. The *nucleopolyhedrosis* bundle virus and the *nucleopolyhedrosis* single-rod virus also differed in 4 and 5 out of 34 terminal amino acids, respectively, from the sequence reported for polyhedrin of a baculovirus of Bombyx mori. In addition, the *nucleopolyhedrosis* single-rod virus had 2 amino acids (Met-Tyr) on the NH2 terminus that were not present on the terminus of *nucleopolyhedrosis* bundle virus or B. mori baculovirus polyhedrin. Approximately half (6) of the total tyrosine residues are clustered in the terminal 20 amino acids of the polyhedrins. Secondary structures predicted from the primary sequence suggest that the tyrosines are clustered in 2 areas. This nonrandom distribution and the pKa of about 10 for tyrosine may be related to the alkali solubility of the polyhedrin.

Keywords/BOMBYX-MORI GENETIC STABILITY.

ROHRMANN-G-F. BEAUDREAU-G-S.
CHARACTERIZATION OF DNA FROM POLYHEDRAL INCLUSION BODIES OF THE *NUCLEOPOLYHEDROSIS* SINGLE ROD VIRUS PATHOGENIC FOR *ORGYIA-PSEUDOTSUGATA.*
VIROLOGY 83 (2). 1977 474-478.
ABSTRACT
A nucleotide sequence complexity of 88.5 .times. 106 was determined for the DNA of the *nucleopolyhedrosis* single-rod (unicapsid) virus of O. *pseudotsugata* using optical renaturation. The genome size was determined to be 85 .times. 106 by comparison of EcoR1 restriction endonuclease fragments with markers of known size using agarose gel electrophoresis. A G+C concentration of 44% for the viral DNA was estimated from its melting properties and buoyant density in CsCl. Evidence from buoyant density in CsCl indicates that DNA which is occluded in the polyhedral matrix but not associated with virions is of viral origin.

Keywords/BACULOVIRUS ECO-R-I RESTRICTION ENDO NUCLEASES.

ROHRMANN-G-F. CARNEGIE-J-W. MARTIGNONI-M-E. BEAUDREAU-G-S.
CHARACTERIZATION OF THE GENOME OF THE *NUCLEOPOLYHEDROSIS* BUNDLE VIRUS PATHOGENIC FOR *ORGYIA-PSEUDOTSUGATA.*
VIROLOGY 80 (2). 1977. 421-425.

VIROLOGY.
ABSTRACT
Reassociation kinetics showed that the DNA from the *nucleopolyhedrosis* bundle virus of O. *pseudotsugata* had a nucleotide sequence complexity of .apprx. 86 .times. 106 daltons using optical renaturation and S1 nuclease assay to follow the renaturation. The MW of the viral DNA by sedimentation analyses was apparently 96 .times. 106. The viral DNA has a *Tm* melting temperature of 76.9.degree. C which corresponds to a G + C base composition of 54%.

Keywords/BACULOVIRUS DNA S-1 NUCLEASE.

ROHRMANN-G-F. LEISY-D-J. CHOW-K-C. PEARSON-G-D. BEAUDREAU-G-S.
IDENTIFICATION CLONING AND R LOOP MAPPING OF THE POLYHEDRIN GENE FROM THE MULTI CAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS OF *ORGYIA-PSEUDOTSUGATA.*
VIROLOGY 121 (1). 1982. 51-60.
VIROLOGY.
ABSTRACT
Polyadenylated RNA was isolated from O. *pseudotsugata* larvae 8-19 days postinfection with the multicapsid *nuclear* *polyhedrosis* virus. This RNA was centrifuged through a sucrose gradient, and fractions enriched for polyhedrin mRNA were identified by in vitro translation. Complementary DNA made to this RNA hybridized predominantly to a 5 kb kilobase fragment of XhoI-digested viral DNA. This fragment was cloned into the plasmid pACYC177 and mapped with restriction endonucleases. A SalI subclone with a 2.5 kb insert derived from the cloned XhoI fragment was found to select by hybridization only polyhedrin mRNA as determined by the size of the in vitro translation product and its precipitation by anti-polyhedrin antibodies. The orientation of the polyhedrin gene and the region of the insert encoding the N terminus of the polyhedrin protein gene and the region of the insert encoding the N terminus of the polyhedrin protein were determined by DNA sequencing. R-Loop mapping indicated polyhedrin mRNA is 980.+-. 75 bases long and contains .apprx. 250 nucleotides not represented in the final protein. The polyhedrin gene had no observable intervening sequences.

Keywords/MULTI CAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS MESSENGER RNA TRANSLATION XHO-I SAL-I RESTRICTION ENDO NUCLEASE.

ROHRMANN-G-F. MARTIGNONI-M-E. BEAUDREAU-G-S.
DNA SEQUENCE HOMOLOGY BETWEEN AUTOGRAPHA-CALIFORNICA AND *ORGYIA-PSEUDOTSUGATA* *NUCLEAR* *POLYHEDROSIS* VIRUSES.
J GEN VIROL 62 (PART 1). 1982. 137-144.
JOURNAL OF GENERAL VIROLOGY.
ABSTRACT
To investigate the DNA sequence homology between the multicapsid *nuclear* *polyhedrosis* virus of A. californica and the multicapsid and single capsid *nuclear* *polyhedrosis* virus of O. *pseudotsugata,* the stringency of hybridization conditions was varied. Homology (13-25%) between the multicapsid viruses of A. californica and O. *pseudotsugata* was detected in 20, 30 and 40% formamide, indicating that fairly stable duplexes were being formed. Under the most stringent conditions in 50% formamide little homology was detected. In contrast to the multicapsid viruses, the single capsid virus of O. *pseudotsugata* demonstrated .apprx. 10% sequence homology in 20% formamide, but these duplexes were unstable and the percentage homology decreased markedly in the higher formamide concentrations. Examination of the specific regions of homology by hybridizing labeled DNA to Southern blots of the virus DNA revealed that the regions of homology between these viruses were not limited to one region of the genome but were found on a number of restriction fragments.

Keywords/MULTI CAPSID VIRUS SINGLE CAPSID VIRUS FORMAMIDE HYBRIDIZATION.

ROHRMANN-G-F. MARTIGNONI-M-E. BEAUDREAU-G-S.
QUANTIFICATION OF 2 VIRUSES IN TECHNICAL PREPARATIONS OF *ORGYIA-PSEUDOTSUGATA* BACULOVIRUS BY MEANS OF BUOYANT DENSITY CENTRIFUGATION OF VIRAL DNA.
APPL ENVIRON MICROBIOL 35 (4). 1978 690-693.
APPLIED AND ENVIRONMENTAL MICROBIOLOGY.
ABSTRACT
A reliable method was developed for the quantitative determination of 2 *nuclear* *polyhedrosis* viruses present in commercially prepared viral insecticides used against O. *pseudotsugata.* DNA, from *nuclear* *polyhedrosis* bundle virus and *nuclear* *polyhedrosis* single-rod virus, were separated on CsCl gradients according to their respective buoyant densities, 1.715 and 1.704 g/ml. The proportions of the 2 viruses were quantified by measuring the relative absorbance at 254 nm of their DNA peaks.

Keywords/*NUCLEAR* *POLYHEDROSIS* BUNDLE VIRUS *NUCLEAR* POLYTHEROSIS SINGLE ROD VIRUS.

ROHRMANN-G-F. MCPARLAND-R-H. MARTIGNONI-M-E. BEAUDREAU-G-S.
GENETIC RELATEDNESS OF 2 *NUCLEOPOLYHEDROSIS* VIRUSES PATHOGENIC FOR *ORGYIA-PSEUDOTSUGATA.*
VIROLOGY 84 (1). 1978 213-217.
VIROLOGY.
ABSTRACT
DNA from 2 *nucleopolyhedrosis* viruses pathogenic for O. *pseudotsugata* showed no common patterns when EcoRI, SmaI, HsuI and BamHI restriction endonuclease fragments of both DNA were compared by agarose-gel electrophoresis. DNA-DNA hybridization indicated at most 1% homology between DNA from the 2 viruses.

Keywords/BACULOVIRUS ECO-R-I SMA-I HSU-I BAM-H-I RESTRICTION ENDO NUCLEASES.

RUSSELL-R-L-Q. PEARSON-M-N. ROHRMANN-G-F.
IMMUNOELECTRON MICROSCOPIC EXAMINATION OF *ORGYIA-PSEUDOTSUGATA* MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS-INFECTED LYMANTRIA-DISPAR CELLS TIME COURSE AND LOCALIZATION OF MAJOR POLYHEDRON-ASSOCIATED PROTEINS.
J GEN VIROL 72 (2). 1991. 275-284.
JOURNAL OF GENERAL VIROLOGY.
ABSTRACT
Immunoelectron microscopy was employted to examine the temporal expression and localization of two proteins involved in baculovirus polyhedron assembly (polyhedrin and p10) of *Orgyia* *pseudotsugata* multicapsid *nuclear* *polyhedrosis* virus (OpMNPV) in infected Lymantria dispar cells. In addition, the association of p10 with the polyhedron envelope (PE) protein was studied. The major capsid protein (p39) was also examined to investigate the association of virion structural proteins with polyhedron formation. In infected cells, p39 did not show a concentrated association with any infected-cell structures other than nucleocapsids and appeared to be randomly distributed over the nucleocapsids surface. Likewise, polyhedrin showed no major concentrations outside of developing or mature polyhedra. The p10 antibody cross-reacted with a protein associated with condensed chromosomes in uninfected cells. In infected cells, p10 is a component of the body of fibrillar structures. The PE protein has been shown to accumulate around the periphery of fibrillar structures. Cells infected with a polyhedrin-minus virus expressing the .beta.-galactosidase gene under the control of the polyhedrin promoter were examined to determine whether the lack of polyhedra would influence the localization of major polyhedron-associated viral proteins. High concentrations of PE protein accumulating on the periphery fibrillar structures appeared to be the major

differences from wild-type virus-infected cells. The .beta.-galactosidase protein appeared to be distributed throughout the nucleus and cytoplasm, in contrast with the specific localization of the viral proteins.

Keywords/BETA GALACTOSIDASE PROTEIN POLYHEDRON ENVELOPE PROTEIN FIBRILLAR STRUCTURES VIRION STRUCTURAL PROTEINS.

RUSSELL-R-L-Q. ROHRMANN-G-F.
A 25-KDA PROTEIN IS ASSOCIATED WITH THE ENVELOPES OF OCCLUDED BACULOVIRUS VIRIONS.
VIROLOGY 195 (2). 1993. 532-540.
VIROLOGY.
ABSTRACT
Antiserum produced against preoccluded virions of the *Orgyia* *pseudotsugata* multinucleocapsid *nuclear* *polyhedrosis* virus (OpMNPV) was used to screen an OpMNPV .lambda.gt11 expression library. One of the immunoreactive clones contained an insert that hybridized to a portion of the OpMNPV HindIII-P fragment. A 2-kb region of HindIII-P was sequenced and found to contain three open reading frames, each preceded by a late promoter element. The insert from the .lambda.gt11 clone was derived from the third open reading frame, which encodes a predicted protein of 25 kDa. The .lambda.gt11 insert was cloned into a pMALcR1 bacterial expression vector and the fusion protein was expressed, isolated, and used for antibody production. This antiserum detected a doublet of approximately 25 kDa on Western blots of a time course of OpMNPV-infected Lymantria dispar cells. The protein was first detected at low concentration by 18 hr p.i.; by 36 hr p.i., the protein concentration had increased significantly and remained at this level for the duration of the time course. Similar results were seen on Western blots of Autographa californica MNPV (AcMNPV)-infected Spodoptera frugiperda cells. No evidence of O- or N-linked glycosylation of the OpMNPV p25 was found. Immunoelectron microscopy showed that p25 was present in the nuclei of OpMNPV-infected cells and localized to the envelopes surrounding polyhedron-derived virions.

Keywords/SPODOPTERA-FRUGIPERDA LYMANTRIA-DISPAR AUTOGRAPHA-CALIFORNICA MULTINUCLEOCAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS *ORGYIA* *PSEUDOTSUGATA* MULTINUCLEOCAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS GENE IDENTIFICATION MOLECULAR SEQUENCE DATA NUCLEOTIDE SEQUENCE AMINO ACID SEQUENCE DDBJ-D13768 EMBL-D13768 GENBANK-D13768 SYNTHESIS KINETICS *NUCLEAR* LOCALIZATION.

RUSSELL-R-L-Q. ROHRMANN-G-F.
NUCLEOTIDE SEQUENCE OF THE UBIQUITIN-39K GENE REGION FROM THE *ORGYIA-PSEUDOTSUGATA* MULTINUCLEOCAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS GENOME.
J GEN VIROL 74 (6). 1993. 1191-1195.
JOURNAL OF GENERAL VIROLOGY.
ABSTRACT
The region of the *Orgyia* *pseudotsugata* multinucleocapsid *nuclear* *polyhedrosis* virus (OpMNPV) genome containing the ubiquitin and the *nuclear* matrix-associated protein (39K) genes was sequenced. The first 77 amino acids of the OPMNPV ubiquitin open reading frame (ORF) showed 84.4% and 79% amino acid sequence identity to Autographa californica multinucleocapsid *nuclear* *polyhedrosis* virus (AcMNPV) and the Spodoptera frugiperda insect ubiquitin, respectively. The predicted OpMNPV ubiquitin protein contains a 3' tail of 16 amino acids not present in the AcMNPV or S. frugiperda ubiquitin ORFs. The OpMNPV 39K ORF showed 56% amino acid sequence identity with the AcMNPV 39K ORF. Four additional ORFs from this region were also characterized.

Keywords/SPODOPTERA-FRUGIPERDA AUTOGRAPHA-CALIFORNICA *NUCLEAR* *POLYHEDROSIS* VIRUS MOLECULAR SEQUENCE DATA NUCLEOTIDE SEQUENCE AMINO ACID SEQUENCE DDBJ-D13375 EMBL-D13375 GENBANK-D13375 *NUCLEAR* MATRIX ASSOCIATED PROTEIN GENE HOMOLOGY.

RUSSELL-R-L-Q. ROHRMANN-G-F.
THE P6.5 GENE REGION OF A *NUCLEAR* *POLYHEDROSIS* VIRUS OF *ORGYIA-PSEUDOTSUGATA* DNA SEQUENCE AND TRANSCRIPTIONAL ANALYSIS OF FOUR LATE GENES.
J GEN VIROL 71 (3). 1990. 551-560.
JOURNAL OF GENERAL VIROLOGY.
ABSTRACT
The gene encoding the basic DNA-binding protein (p6.5) of the multicapsid *nuclear* *polyhedrosis* virus of *Orgyia* *pseudotsugata* (OpMNPV) was localized by Southern blot analysis using a cDNA probe containing the Autographa californica virus (AcMNPV) p6.9 gene. The OpMNPV p6.5 gene was mapped to the HindIII G framgent at map unit 67. Nucleotide sequence and transcriptional analysis of a 3.26 kb region encompassing this area revealed four open reading frames (ORFs 1 to 4) oriented in the same direction. ORF 1 demonstrated a seven codon overlap with ORF 2. Messenger RNAs initiated upstream of each of the four ORFs late in infection and were coterminal at a single site downstream of the fourth ORF. The conserved late gene promoter/mRNA start site sequence (ATAAG) was present upstream of all the ORFs, but did not appear to be the major site of mRNA initation for the third ORF, as determined by primer extension analysis. The fourth ORF in this series encoded a predicted peptide of 51 amino acids (6.5K), which was 80% similar to the p6.9 basic DNA-binding protein of AcMNPV.

Keywords/AUTOGRAPHA-CALIFORNICA *NUCLEAR* *POLYHEDROSIS* VIRUS OPEN READING FRAME MOLECULAR SEQUENCE DATA NUCLEOTIDE SEQUENCE AMINO ACID SEQUENCE EMBL-D00514 GENBANK-D00514 DDBJ-D00514.

RUSSELL-R-L-Q. ROHRMANN-G-F.
A BACULOVIRUS POLYHEDRON ENVELOPE PROTEIN IMMUNOGOLD LOCALIZATION IN INFECTED CELLS AND MATURE POLYHEDRA.
VIROLOGY 174 (1). 1990. 177-184.
VIROLOGY.
ABSTRACT
A polyclonal antiserum against a trpE fusion protein containing the complete open reading frame of the polyhedron envelope (PE) protein from the *nuclear* *polyhedrosis* virus of *Orgyia* pseudotsugate(OpMNPV) was used for immunogold staining and electron microscopic examination of polyhedra, isolated polyhedron envelopes, and infected insect cells at selected times postinfection. The antiserum specifically stained the peripheral envelope of mature polyhedra and also stained the envelope structure which remained after polyhedra were dissolved in dilute alkaline solutions. In Op-MNPV-infected Lymantria dispar cells, the PE protein was detected by 48 hr postinfection (hr p.i.) but specific localization and staining of developing polyhedra were not evident. However, by 72 hr p.i. substantial and preferential staining of the periphery of developing polyhedra was evident even though a distinct polyhedron envelope was not yet observed. In addition, the periphery of fibrillar structures was stained by the PE antiserum. By 96 hr p.i., mature envelopes surrounded polyhedra and these polyhedron envelopes were stained with the PE antibody. The progression of PE protein staining during polyhedron morphogenesis indicates that the PE protein accumulates and becomes associated with developing polyhedra in the nucleus between 48 and 72 hr p.i. Very late in infection the mature polyhedron envelope forms on the polyhedron surface. The apparent affinity of the PE protein for the surface of maturing polyhedra suggests that it may be a major component of the polyhedron envelope or may form the matrix for the deposition of other components which contribute to the mature envelope. Immunogold staining and protease digestion experiments indicate that protein is an essential component of the polyhedron envelope.

Keywords/*ORGYIA-PSEUDOTSUGATA* *NUCLEAR* *POLYHEDROSIS* VIRUS LYMANTRIA-DISPAR CELLS ENVELOPE COMPONENT MORPHOGENESIS.

SCHAFER-M-P. ROHRMANN-G. HEINE-U. BEAUDREAU-G-S.
DNA FROM 2 *ORGYIA-PSEUDOTSUGATA* BACULOVIRUSES MOLECULAR WEIGHT DETERMINATION BY MEANS OF ELECTRON MICROSCOPY AND RESTRICTION ENDO NUCLEASE ANALYSIS.
VIROLOGY 95 (1). 1979. 176-184.
VIROLOGY.
ABSTRACT
Aqueous and urea-formamide procedures for spreading nucleic acid were employed for EM studies on the DNAs from the *nucleopolyhedrosis* bundle virus (NPBV) and the *nucleopolyhedrosis* single-rod virus (NPSV) both of which are pathogenic for O. *pseudotsugata.* The molecular weight estimates via EM were derived by comparison of the mean length values for the double-stranded, relaxed circular DNAs with that of SV-40 DNA. The aqueous and urea-formamide spreading methods yielded NPSV DNA MW values of 103 .times. 106 and 104 .times. 106 daltons, respectively, and MW values of 87 .times. 106 and 85 .times. 106 daltons for NPBV DNA. These molecular weights were compared with molecular weight estimates from restriction endonuclease analysis, sedimentation analysis and renaturation kinetic analysis. DNA located within the NPBV polyhedra but external to virions was characterized by restriction endonuclease analysis and examined by EM. It was determined to be composed of fragments of random size and to be of viral origin.

Keywords/SV-40 COMPARISON *MOTH* PATHOGENS SEDIMENTATION ANALYSIS RENATURATION KINETIC ANALYSIS.

SHAPIRO-M. MARTIGNONI-M-E. CUNNINGHAM-J-C. GOODWIN-R-H.
POTENTIAL USE OF THE SALT MARSH CATERPILLAR ESTIGMENE-ACREA AS A PRODUCTION HOST FOR *NUCLEOPOLYHEDROSIS* VIRUSES.
J ECON ENTOMOL 75 (1). 1982. 69-71.
JOURNAL OF ECONOMIC ENTOMOLOGY.
ABSTRACT
The virulence of the *nucleopolyhedrosis* viruses (NPVs) of *Douglas* *fir* *tussock* *moth,* *Orgyia* *pseudotsugata* (McDunnough), spruce budworm, Choristoneura fumiferana (Clemens) and gypsy *moth,* Lymantria dispar (L.), for larvae of the saltmarsh caterpillar, Estigmene acrea (Drury), was enhanced after successive passage in the alternate host. In all cases, yields of 2 .times. 109 polyhedral inclusion bodies were obtained per E. acrea larva, which represented at least a 4-fold increase in O. *pseudotsugata* and C. fumiferana NPVs obtained from the respective natural hosts. The O. *pseudotsugata-NPV-E.* acrea system appears to be an excellent system for production of *Douglas* *fir* *tussock* *moth* NPV on the basis of both virus yield and activity. The C. fumiferana NPV-E. acrea and L. dispar NPV-E. acrea systems appear less promising on the basis of virus activity.

Keywords/*ORGYIA-PSEUDOTSUGATA* CHORISTONEURA-FUMIFERANA LYMANTRIA-DISPAR POLYHEDRAL INCLUSION BODY.

SHEA-P-J.
TESTING OF CHEMICAL AND MICROBIAL INSECTICIDES FOR SAFETY SOME TECHNIQUES.
BULL ENTOMOL SOC AM 23 (3). 1977. 176-178.
BULLETIN OF THE ENTOMOLOGICAL SOCIETY OF AMERICA.

Keywords/BACILLUS-THURINGIENSIS *NUCLEAR* *POLYHEDROSIS* VIRUS *DOUGLAS-FIR* *TUSSOCK* *MOTH* BEE BIRD SMALL MAMMAL DIMILIN ORTHENE SEVIN RESIDUE.

SHEPHERD-R-F. BENNETT-D-D. DALE-J-W. TUNNOCK-S. DOLPH-R-E. THIER-R-W.

EVIDENCE OF SYNCHRONIZED CYCLES IN OUTBREAK PATTERNS OF *DOUGLAS-FIR* *TUSSOCK* *MOTH* *ORGYIA-PSEUDOTSUGATA* MCDUNNOUGH LEPIDOPTERA LYMANTRIIDAE.
MEM ENTOMOL SOC CAN (146). 1988. 107-122.
MEMOIRS OF THE ENTOMOLOGICAL SOCIETY OF CANADA.
ABSTRACT
Outbreak patterns of *Douglas-fir* *tussock* *moth,* *Orgyia* *pseudotsugata* (McDunnough), over western North America historically appear to be synchronous, particularly in British Columbia Canada, Washington, Oregon, and northern Idaho USA. Populations of the insect increase to outbreak and collapse in a variable cycle, averaging 9 years between peaks. A review of all outbreaks suggests repeated, widespread, *nucleopolyhedrosis* viral epizootics are responsible for the collapse of the population and, hence, the cycle. The virus appears to survive in the soil between outbreaks and to be carried incidentally to foliage where it is occasionally consumed by larvae. Ingestion of a single particle is probably sufficient to cause infection. Population of the *moth* increase until density reaches the point where larvae to larvae infection is established. The viral inoculum builds rapidly following that point and spreads widely so that distant populations at all densities become infected, and collapse in the same year. The epizootic continues for another year. Then foliage contamination disappears, and populations reach their lowest densities before starting the cycle again.

Keywords/*NUCLEOPOLYHEDROSIS* VIRUS LARVA SURVIVAL SOIL BRITISH COLUMBIA CANADA WASHINGTON OREGON IDAHO USA.

SHEPHERD-R-F. OTVOS-I-S. CHORNEY-R-J. CUNNINGHAM-J-C.
PEST MANAGEMENT OF *DOUGLAS-FIR* *TUSSOCK* *MOTH* *ORGYIA-PSEUDOTSUGATA* LEPIDOPTERA LYMANTRIIDAE PREVENTION OF AN OUTBREAK THROUGH EARLY TREATMENT WITH A *NUCLEAR* *POLYHEDROSIS* VIRUS BY GROUND AND AERIAL APPLICATIONS.
CAN ENTOMOL 116 (11). 1984. 1533-1542.
CANADIAN ENTOMOLOGIST.
ABSTRACT
Two different application methods were tested using a *nuclear* *polyhedrosis* virus as a control agent at an early stage in the outbreak cycle of *Douglas-fir* *tussock* *moth,* O. *pseudotsugata* (McDunnough), in south central British Columbia Canada in 1981. The virus, which often leads to the development of an epizootic late in the outbreak cycle, was propagated in whitemarked *tussock* *moth,* O. leucostigma (J. E. Smith). A helicopter fitted with a boom and nozzle was used for treating 4 plots (total area 19.8 ha) at a dosage of 2.2 .times. 1011 polyhedral inclusion bodies (PIB) in an emitted volume of 11.3 l ha-1. Five to eight weeks after spraying, microscopic examination of live larvae showed that 77-100% were infected. In ground-spray applications of 2 other plots, a modified orchard-type sprayer was used to apply 2.4 .times. 1010 PIB in a volume of 4.5 l/free. Microscopic diagnosis of live larvae at 8 wk post-spray revealed 83 and 85% infection. In autumn 1981, no egg masses were found in the plots treated earlier that year and no larvae were found on the sample trees in 1982 or 1983. The treatment was effective over a range of initial mean larval densities of 41-206 m-2 of foliage. At the same time, populations in nearby untreated areas increased in 1982. Little foliage protection was obtained the year of application due to the lengthy virus incubation period, but the trees recovered quickly when populations disappeared due to the virus epizootic.

Keywords/*ORGYIA-LEUCOSTIGMA* BRITISH-COLUMBIA CANADA LARVAL DENSITY INFECTION RATE APPLICATION METHOD MICROBIAL CONTROL.

SOHI-S-S. PERCY-J. CUNNINGHAM-J-C. ARIF-B-M.
REPLICATION AND SERIAL PASSAGE OF A MULTI CAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS OF *ORGYIA-PSEUDOTSUGATA* LEPIDOPTERA LYMANTRIIDAE IN CONTINUOUS INSECT CELL LINES.

CAN J MICROBIOL 27 (11). 1981. 1133-1139.
CANADIAN JOURNAL OF MICROBIOLOGY.
ABSTRACT
A multicapsid *nuclear* *polyhedrosis* virus (MNPV) of the *Douglas-fir* *tussock* *moth,* O. *pseudotsugata,* propagated in larvae of the white-marked *tussock* *moth,* O. leucostigma, was successfully grown in 2 continuous cell lines developed from minced neonate larvae of O. leucostigma. Polyhedral inclusion bodies (PIB) appeared in the nuclei of cells within 24 h after inoculation. Cytopathological changes, as revealed by light microscopy and EM, were typical of an MNPV. The virus was passaged in the cell cultures 55 times. The level of infection during passaging varied from 15-98% of the cells and the number of PIB/cell varied from 10-40. The PIB from the 4th passage of the virus in cell cultures were almost as pathogenic to O. leucostigma larvae as the PIB produced in larvae.

Keywords/*ORGYIA-LEUCOSTIGMA* POLYHEDRAL INCLUSION BODIES CYTO PATHOLOGICAL CHANGE PATHOGENIC.

STEINHAUS-E-A.
REPORT ON DIAGNOSIS OF DISEASED INSECTS 1944-1950
HILGARDIA 20(22). 1951. 629-678

STELZER-M-J
EPIZOOTIOLOGICAL INVESTIGATIONS. PART IV. IN RESULTS OF FIELD EXPERIMENTS FOR CONTROLLING DOUGLAS-FIR TUSSOCK MOTH WITH AERIAL APPLICATION OF POLYHEDROSIS VIRUS AND ASSOCIATED STUDIES.
USDA FOR. SERV. PAC. NORTHWEST FOR. AND RANGE AND EXP. STN. CORVALLIS, OREG. PROG. REP. 1972. 8P.

STELZER-M-J; NEISESS-J; CUNNINGHAM-J-C; MCPHEE-J-R.
FIELD EVALUATION OF BACULOVIRUS STOCKS AGAINST DOUGLAS-FIR TUSSOCK MOTH IN BRITISH COLUMBIA
J. ECON. ENTOMOL 70(2). 1977. 243-264
JOURNAL OF ECONOMIC ENTOMOLOGY

STELZER-M-J. NEISESS-J. THOMPSON-C-G.
AERIAL APPLICATIONS OF A *NUCLEOPOLYHEDROSIS* VIRUS AND BACILLUS-THURINGIENSIS AGAINST THE *DOUGLAS-FIR* *TUSSOCK* *MOTH.*
J ECON ENTOMOL 68 (2). 1975. 269-272.
JOURNAL OF ECONOMIC ENTOMOLOGY.

Keywords/*ORGYIA-PSEUDOTSUGATA* PSEUDOTSUGA-MENZIESII-VAR-GLAUCA ABIES-GRANDIS MOLASSES.

STIPE-L.
DOUGLAS-FIR *TUSSOCK* *MOTH* POPULATION ASSESSMENT AND CONTROL
NORTHWEST ENVIRON J 4 (2). 1988. 339-341.
NORTHWEST ENVIRONMENTAL JOURNAL.

Keywords/*NUCLEAR* *POLYHEDROSIS* VIRUS PHEROMONE TRAPPING FOREST MANAGEMENT IDAHO OREGON USA.

THEILMANN-D-A. STEWART-S.
ANALYSIS OF THE *ORGYIA-PSEUDOTSUGATA* MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS TRANS-ACTIVATORS IE-1 IE-2 USING MONOCLONAL ANTIBODIES.
J GEN VIROL 74 (9). 1993. 1819-1826.
JOURNAL OF GENERAL VIROLOGY.
ABSTRACT
We have produced monoclonal antibodies against two *Orgyia* *pseudotsugata* multicapsid *nuclear* *polyhedrosis* virus (OpMNPV) transcriptional trans-activators, IE-1 and IE-2. Temporal analysis of IE-1 and IE-2 proteins have shown that IE-1 continues to increase in steady-state levels from 0 to 120 h post-infection, whereas IE-2 declines by 36 h post-infection. At least five different electrophoretic forms of IE-1 are present in OpMNPV- infected LD652Y cells of which three appear to be from the non-spliced IE-I gene. Cotransfection experiments also showed that IE-1 causes a reduction in the levels of IE-2 protein but concurrently IE-2 increases IE-1 expression. Western blot analysis indicated that a form of IE-I copurified with budded virions but did not copurify with the polyhedron-derived virus.

Keywords/PROTEIN TRANSCRIPTIONAL TRANS-ACTIVATOR.

THEILMANN-D-A. STEWART-S.
TANDEMLY REPEATED SEQUENCE AT THE 3' END OF THE IE-2 GENE OF THE BACULOVIRUS *ORGYIA-PSEUDOTSUGATA* MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS IS AN ENHANCER ELEMENT.
VIROLOGY 187 (1). 1992. 97-106.
VIROLOGY.
ABSTRACT
An enhancer element was identified in the virus *Orgyia* *pseudotsugata* multicapsid *nuclear* *polyhedrosis* virus (OpMNPV) that is located adjacent to the 3' end of the IE-2 geen and 5' to an open reading frame that codes for a predicted protein that has 37% homology to the AcMNPV PE-38 gene. The OpMNPV enhancer (OpE) consists of a 66-bp element that is tandemly repeated partially or completely 12 times. The OpE sequences were shown to increase gene expression from the Autographa californica MNPV delayed early p39 promoter independently of position or orientation, and were also shown to increase expression from the promoter of the OpMNPV immediate early gene, IE-2. Sequences homologous to the OpE sequences were mapped by Southern blot hybridization to four additional locations around the OpMNPV genome. This indicates that OpMNPV is similar to other beculoviruses such as AcMNPV, Lymantria dispar MNPV, and Choristoneura fumiferana MNPV that have homologous regions in several locations in the genome.

Keywords/AUTOGRAPHA-CALIFORNICA *NUCLEAR* *POLYHEDROSIS* VIRUS LYMANTRIA-DISPAR MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS CHORISTONEURA-FUMIFERANA MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS IMMEDIATE EARLY 2 GENE NUCLEOTIDE SEQUENCE AMINO ACID SEQUENCE MOLECULAR SEQUENCE DATA.

THEILMANN-D-A. STEWART-S.
MOLECULAR ANALYSIS OF THE TRANS-ACTIVATING IE-2 GENE OF *ORGYIA-PSEUDOTSUGATA* MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS.
VIROLOGY 187 (1). 1992. 84-96.
VIROLOGY.
ABSTRACT
A second immediate early (IE) regulatory gene of the baculovirus *Orgyia* *pseudotsugata* multicapsid *nuclear* *polyhedrosis* virus (OpMNPV) has been identified. The IE-2 gene which is homologous to the IE-N gene of Autographa californica MNPV was mapped to the HindIII A fragment of OpMNPV between 0.41 to 1.37 map units. The IE-2 gene codes for a predicted protein of 45,640 Da and analysis of the amino

acid sequence shows that the protein has a highly basic amino terminal domain and a cysteine-rich domain that is similar to a zinc finger motif that is also found in the baculovirus proteins GC30 and PE-38. The IE-2 gene is expressed as a 1.3-kb transcript that was detectable by 0.5 hr postinfection (hr p.i.), reached maximum steady state levels by 6 hr p.i., and declined slightly by 48 hr p.i. Cis-acting 5' regulatory sequences were analyzed by deletion analysis of the IE-2 promoter linked to the reporter gene chloramphenicol acetyl transferase. Maximum expression was obtained when the IE-2 promoter contained sequences 275 bp upstream from the transcriptional start site. trans-Activation analysis revealed that IE-2 trans-activated the IE-1 promoter and in addition appeared to be autoregulatory.

Keywords/AUTOGRAPHA-CALIFORNICA *NUCLEAR* *POLYHEDROSIS* VIRUS HOMOLOGY IMMEDIATE EARLY 2 GENE GENE MAPPING NUCLEOTIDE SEQUENCE AMINO ACID SEQUENCE MOLECULAR SEQUENCE DATA TRANSCRIPTION TEMPORAL KINETICS CIS-ACTING REGULATORY SITES IMMEDIATE EARLY 1 IE-1 PROMOTER ACTIVATION AUTOREGULATION GENE REGULATION.

THEILMANN-D-A. STEWART-S.
IDENTIFICATION AND CHARACTERIZATION OF THE IE-1 GENE OF *ORGYIA-PSEUDOTSUGATA* MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS.
VIROLOGY 180 (2). 1991. 492-508.
VIROLOGY.
ABSTRACT
The IE-1 gene of *Orgyia* *pseudotsugata* multicapsid *nuclear* *polyhedrosis* virus (OpMNPV) was mapped between 95.7 and 97.1 map units on the viral genome. Sequence analysis of the OpMNPV IE-1 gene (OpIE-1) identified an open reading frame that coded for a predicted protein of 560 amino acids with a molecular weight of 64,775. Transcriptional analysis of OpMNPV-infected Lymantria dispar (LD652Y) cells identified two RNAs homologous to the OpIE-1 open reading frame that were 1.7 and 1.9 kb in size. The 1.7-kb transcript could be detected by 0 hr postinfection (hr p.i.) and the steady-state levels increased up to 48 hr p.i. The 1.9-kb message appears to be spliced and has peak expression from 4 to 6 hr p.i. but can still be detected at late times p.i. Comparison of the OpIE-1 and Autographa californica multicapsid *nuclear* *polyhedrosis* virus (AcMNPV) IE-1-predicted proteins revealed that the N-terminal region had very low sequence identity (21%) but had maintained an acidic profile, whereas the C-terminal region showed 55% amino acid identity. Transient assay showed that OpIE-1 was able to trans-activate the AcMNPV delayed early reproter gene construct p39CAT in both LD652Y cells and Spodoptera frigiperda (Sf9) cells. The expression of p39CAT trans-activated by OpIE-1 was also found to be enhanced by the AcMNPV hr enhancer sequences. The OpIE-1 promoter was linked to the chloramphenicol acetyl transferase gene and deletion analysis was used to identify regions involved in the regulation of this gene. This analysis revealed that the OpIE-1 promoter contained regions that were responsive to a transcriptional activator that was specific to Sf9 cells. In addition it was shown that OpIE-1 could trans-activate its own promoter and that for maximal expression this required sequences between -420 and -330 relative to the transcriptional start site. These data suggest that OpIE-1 is autoregulated during normal viral infection of insect cells.

Keywords/LYMANTRIA-DISPAR LD652Y CELLS SPODOPTERA-FRUGIPERDA SF9 CELLS AUTOGRAPHA-CALIFORNICA MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS MAP POSITION HOMOLOGY TRANSCRIPTION KINETICS IMMEDIATE EARLY GENE TRANS-ACTIVATION TRANSCRIPTION FACTOR BINDING SITE AUTOREGULATION AMINO ACID SEQUENCE NUCLEOTIDE SEQUENCE MOLECULAR SEQUENCE DATA.

THOMPSON-C-G. SCOTT-D-W.
PRODUCTION AND PERSISTENCE OF THE *NUCLEAR* *POLYHEDROSIS* VIRUS OF THE *DOUGLAS-FIR* *TUSSOCK* *MOTH* *ORGYIA-PSEUDOTSUGATA* LEPIDOPTERA LYMANTRIIDAE IN THE FOREST ECOSYSTEM.
J INVERTEBR PATHOL 33 (1). 1979. 57-65.

JOURNAL OF INVERTEBRATE PATHOLOGY.
ABSTRACT
The production and persistence of the *nuclear* *polyhedrosis* (NP) virus of the *Douglas-fir* *tussock* *moth,* O. *pscudotsugata,* was determincd by periodic sampling of natural and induced epizootics. Low prevalence rates during the early instars result mainly in larval mortality of older instars which leads to the greatest production and persistence of polyhedra in the forest ecosystem. Infections in the last 2 larval instars are responsiblc for the majority of the polyhcdra produced. Virus produced during the early instars is largely inactivatcd beforc it is incorporated into duff or soil. Active virus once incorporated in the duff layer is subject to littlc vcrtical distribution in the soil and remains active for at least 11 yr. Direct control measures, applied beforc NP dcvelops naturally, may prevent the accumulation and persistence of virus in forest duff and soil. The NP virus of thc *Douglas-fir* *tussock* *moth* can be reintroduced into the forest canopy through contamination of foliage by dust-borne virus.

Keywords/FOREST ECOSYSTEM EPIZOOTIC PREVALENCE RATE LARVAL MORTALITY SOIL VERTICAL DISTRIBUTION.

THOMPSON-C-G. SCOTT-D-W. WICKMAN-B-E.
LONG-TERM PERSISTENCE OF THE *NUCLEAR* *POLYHEDROSIS* VIRUS OF THE *DOUGLAS-FIR* *TUSSOCK* *MOTH* *ORGYIA-PSEUDOTSUGATA* LEPIDOPTERA LYMANTRIIDAE IN FOREST SOIL.
ENVIRON ENTOMOL 10 (2). 198I. 254-255.
ENVIRONMENTAL ENTOMOLOGY.
ABSTRACT
The long-term persistence of the *nuclear* *polyhedrosis* virus NPV of the *Douglas-fir* *tussock* *moth,* O. *pseudotsugata* (McDunnough), in forest soil was established by bioassaying soil and duff samples from an area in which the last *tussock* *moth* outbreak occurred in 1936-1938. Samples were taken from beneath each of 75 white *fir,* Abies concolor (Gord. and Glend.) Lindl., trees selected within 17clusters in a study area in the Inyo National Forest, California USA. Virus was present in 15 soil samples from 9 of the clusters. Although prescnt concentrations of active virus are low (< PIBpolyhedral inclusion bodies/cm3), enough remains in the mineral soil from sheltered locations to infect *tussock* *moth* larvae. Absence of active RPV in the duff layers above the positive soil samples indicates the duff has accumulated since the last epizootic of *tussock* *moth* *nuclear* *polyhedrosis.*

Keywords/EPIZOOTIC MINERAL SOIL CALIFORNIA USA.

THOMPSON-C-G.
EPIZOOTIOLOGY OF THE NUCLEAR POLYHEDROSIS OF THE DOUGLAS FIR TUSSOCK MOTH
USDA DFTM RES. AND DEV. PROGRAM FINAL REP. 1977. 47P.

TUCKER-R-K.
SUBACUTE ORAL TREATMENT, MALLARD HENS. VIRUS (HEMEROCAMPA PSEUDOTSUGATA).
U. S. DEP. INTER. FISH AND WILDL. SERV., DENVER WILDL. RES. CENT. DENVER, COLO.
INTERN REP. SUPPLEMENT 1. 1967. IP.

TUCKER-R-K; CRABTREE-D-G.
HANDBOOK OF TOXICITY OF PESTICIDES TO WILDLIFE
U.S. DEPT. INTER. RESOUR. PUBL. 84. 1970. I31 P.
U.S. DEPT. INTER. (FISH WILDL. SERV.), DENVER RES. CENT., COLO

VEZINA-A. PETERMAN-R-M.
TESTS OF THE ROLE OF A *NUCLEAR* *POLYHEDROSIS* VIRUS IN THE POPULATION DYNAMICS OF ITS HOST *DOUGLAS-FIR* *TUSSOCK* *MOTH* *ORGYIA-PSEUDOTSUGATA* LEPIDOPTERA LYMANTRIIDAE.
OECOLOGIA (BERL) 67 (2). 1985. 260-266.
OECOLOGIA (BERLIN).
ABSTRACT
Outbreaks of the *Douglas-fir* *tussock* *moth,* *Orgyia* pseudotsugta (McDunnough), have recurred periodically, at 7- to 10-ycar intervals,since the first recorded observation in 1916 in Chase, British Columbia, Canada. Anderson and May (1981) hypothesized that microparasites are responsible for the periodic population fluctuations of some defoliating insects. We chose the association between the *Douglas-fir* *tussock* *moth* and a viral disease, caused by a *nuclear* *polyhedrosis* virus (NPV), to test whether their model, and variants thereof, can predict the obscrved population cycles Density-dependent mortality, vertical transmission of the virus and an incubation period werc added to the free-living stages model of Anderson and May (1981). Paramcter values for the modcls were derived from published data and from an experiment. Sensitiivty analyses conducted for each model showed that none of the models generated the behavior of the *Douglas-fir* *tussock* *moth* as observed in the field. Thus, the periodicity of the outbreaks in field populations of *tussock* *moths* cannot be explained solely by the dynamics of the viral disease as described by Anderson and May's class of models; the virus is too short-lived and the growth rate of the insect population too high. Dynamics of other system components such as predators, parasites or food of the *tussock* *moth* probably play a significant role in the insect's population dynamics.

Keywords/POPULATION FLUCTUATION DEFOLIATING INSECT DENSITY DEPENDENT MORTALITY OUTBREAK PERIODICITY PREDATOR FOOD ANDERSON AND MAY MODEL BRITISH-COLUMBIA CANADA.

WOLF-K.
EVALUATION OF THE EXPOSURE OF FISH AND WILDLIFE TO NUCLEAR POLYEDROSIS AND GRANULOSIS VIRUSES. IN BACULOVIRUSES FOR INSECT PEST CONTROL: SAFETY CONSIDERATIONS
AM. SOC. MICROBIOL. 1975. P. 109-111
M. SUMMERS, R. ENGLER, L. A. FALCON, AND P. V. VAIL, EDS.

WOLGAMOT-G-M. GROSS-C-H. RUSSELL-R-L-Q. ROHRMANN-G-F.
IMMUNOCYTOCHEMICAL CHARACTERIZATION OF P24 A BACULOVIRUS APSID-ASSOCIATED PROTEIN.
J GEN VIROL 74 (1). 1993. 103-107.
JOURNAL OF GENERAL VIROLOGY.
ABSTRACT
An open reading frame (ORF 1) located upstream of the polyhedron envelope protein gene in the *Orgyia* *pseudotsugata* multinucleocapsid *nuclear* *polyhedrosis* virus (OpMNPV) genome was cloned in-frame into a trpE bactcrial expression vector. The fusion protein produced by this construct was used for the preparation of a monospecific antiserum. Western blot analysis of extracts from OpMNPV-infected Lymantria dispar cells and Autographa california NPV (AcMNPV)-infected Spodoptera frugiperda cells detected a 24K protein latc in infection. This antiserum also reacted with a 24K protein in preparations of budded and polyhedra-dcrived virus from OpMNPV and AcMNPV. The 24K protein was not N-glycosylated. Immunoelectron microscopy confirmed that the OpMNPV p24 is associated with nucleocapsids of budded and polyhedra-dcrived virions.

Keywords/SPODOPTERA-FRUGIPERDA LYMANTRIA-DISPAR AUTOGRAPHA-CALIFORNICA *NUCLEAR* *POLYHEDROSIS* VIRUS *ORGYIA-PSEUDOTSUGATA* MULTINUCLEOCAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS BUDDED VIRION POLYHEDRA DERIVED VIRION.

WRIGHT-K-H; MASON-R-R.
DOUGLAS-FIR TUSSOCK MOTH VIRUS TESTS. PHASE II: FIELD TESTS AT MT. HOOD, OREGON, TO DETERMINE PERFORMANCE OF VIRUS WATER SPRAYS.
PROG. REP. ON FILE USDA FOR. SERV., PAC. NORTHWEST FOR. AND RANGE EXP. STN., FOR. INSECT RES., PORTLAND, OREG. 1966. 36P.

WU-X. STEWART-S. THEILMANN-D-A.
CHARACTERIZATION OF AN EARLY GENE CODING FOR A HIGHLY BASIC 8-9K PROTEIN FROM THE *ORGYIA* *PSEUDOTSUGATA* MULTICAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS.
J GEN VIROL 74 (8). 1993. 1591-1598.
JOURNAL OF GENERAL VIROLOGY.
ABSTRACT
A new gene of the baculovirus *Orgyia* *pseudotsugata* multicapsid *nuclear* *polyhedrosis* virus (OpMNPV) has been identified that encodes a highly basic 8.9K protein. The gene called p8.9 is expressed as a 0.5 kb transcript by 1 h post-infection and initiates at an early gene motif The promoter of the 0.5 kb transcript has two upstream elements, repeats I and II, which are similar to motifs previously characterized in the OpMNPV IE-2 gene and the Autographa californiea *nuclear* *polyhedrosis* virus IEN and PE38 genes. A second p8.9 transcript expressed from 8 to 72 h post-infection was shown to initiate 634 bp upstream from the early gene motif in a region that has no similarity to any previously described baculovirus promoter or initiation site. Transient assays utilizing a reporter gene have shown that the p8.9 early promoter is active in a Lymantria dispar (LD652Y) and Spodoptera frugipeda (Sf9) cell lines in the absence of other viral factors. In addition, it was also demonstrated that the p8-9 promoter is trans-activated by the OpMNPV IE-2 and p34 genes, but not by IE-1.

Keywords/SPODOPTERA-FRUGIPERDA LYMANTRIA-DISPAR LD652Y CELLS SF9 CELLS AUTOGRAPHA-CALIFORNICA *NUCLEAR* *POLYHEDROSIS* VIRUS MOLECULAR SEQUENCE DATA NUCLEOTIDE SEQUENCE AMINO ACID SEQUENCE PROMOTER REPEATS GENE REGULATION TRANS-ACTIVATION IE-2 GENE PRODUCT P34 GENE PRODUCT.

WU-X. STEWART-S. THEILMANN-D-A.
ALTERNATIVE TRANSCRIPTIONAL INITIATION AS A NOVEL MECHANISM FOR REGULATING EXPRESSION OF A BACULOVIRUS TRANS ACTIVATOR.
J VIROL 67 (10). 1993. 5833-5842.
JOURNAL OF VIROLOGY.
ABSTRACT
In this report, we show that the *Orgyia* *pseudotsugata* *nuclear* *polyhedrosis* virus p34 gene, which is homologous to the Autographa californiea *nuelear* *polyhedrosis* virus PE-38 gene, is a trans aetivator. The predieted p34 protein eontains a number of motifs that are similar to those found in other eukaryotie transeriptional trans aetivators, including a putative zine finger DNA-binding domain, a glutamine-rich domain, and a leueine zipper. Northern (RNA) blot analysis showed that the p34 gene is expressed as a 1.1-kb mRNA from 1 to 48 h postinfection and as a 0.7-kb mRNA from 18 to 120 h postinfection. Mapping of these transeripts showed that they were 3' eoterminal but initiated at different 5' start sites. The 1.1-kb transeript initiates at a baeulovirus early gene motif (CACAGT) and encodes the entire p34 open reading frame (ORF). The 0.7-kb transeript initiates at a baeulovirus late gene start site (GTAAG) internal to the p34 ORF. Western blot (immunoblot) analysis using p34 antisera showed that the 0.7-kb transeript is translated as an amino-terminally truncated 20-kDa form of the full length 34-kDa protein. Funetional analysis indieated that the 34-kDa protein transeriptionally trans aetivates the IE-2 promoter whereas the 20-kDa protein does not. Therefore, p34 produces two funetionally different proteins from the same ORF, using the novel meehanism of alternative transeriptional initiation.

Keywords/*ORGYIA-PSEUDOTSUGATA* *NUCLEAR* *POLYHEDROSIS* VIRUS MOLECULAR SEQUENCE DATA AMINO ACID SEQUENCE GENE REGULATION P34 PROTEIN IMMEDIATE-EARLY IE-2 PROMOTER TRANSCRIPT MAPPING.

YOUNG-V-D.
DOUGLAS-FIR TUSSOCK MOTH VIRUS TESTS. PHASE 1: DEVELOPMENT OF EQUIPMENT AND METHODS FOR APPLYING VIRUS WATER SPRAYS.
PROGRESS REP. ON FILE USDA AGRIC. RES. SERV., AGRIC. ENG. RES. DIV., FOREST GROVE, OREG. 1966. 21 P.

ZANOTTO-P-M-D-A. SAMPAIO-M-J. JOHNSON-D-W. ROCHA-T-L. MARUMIAK-J-E.
THE ANTICARSIA-GEMMATALIS *NUCLEAR* *POLYHEDROSIS* VIRUS POLYHEDRIN GENE REGION SEQUENCE ANALYSIS GENE PRODUCT AND STRUCTURAL COMPARISONS.
J GEN VIROL 73 (5). 1992. 1049-1056.
JOURNAL OF GENERAL VIROLOGY.
ABSTRACT
The genomic region of the Anticarsia gemmatalis multiple nucleocapsid nulcear *polyhedrosis* virus (AgMNPV) strain 2D encoding the polyhedrin gene was cloned and mapped, and a 2085 bp SphI-PstI fragment containing the gene was sequenced. The polyhedrin polypeptide of the parental isolate AgMNPV was manually sequenced, and the amino acid sequence obtained agreed with that deduced from the DNA coding region sequence. AgMNPV and *Orgyia* *pseudotsugata* MNPV (OpMNPV) are similar in terms of promoter structure and polyhderin primary sequences, and the polyhedrin gene of both viruses is transcribed in the anti-clockwise direction in relation to their physical maps. The region upstream from the polyhedrin gene of AgMNPV, OpMNPV, Bombyx mori NPV and Autographa californica MNPV (AcMNPV) was compared and this showed that the open reading frame (ORF) common to all four viruses (ORF 5) has sequence homology with the AcMNPV 25K gene. The sequences between ORF 5 and the polyhedrin gene were found to be variable among the polyhedrin gene loci compared. Additionally, conserved elements in the promoters of the very late genes encoding polyhedrin and granulin, and those encoding two p10 proteins were found to share sequence homology and positional similarity with consensus regions in the conserved boxes A and C, responsible for binding transcription factors to eukaryotic 5S ribosomal RNA genes, and to box C of tRNA genes.

Keywords/AUTOGRAPHA-CALIFORNICA *NUCLEAR* *POLYHEDROSIS* VIRUS *ORGYIA-PSEUDOTSUGATA* MULTIPLE NUCLEOCAPSID *NUCLEAR* *POLYHEDROSIS* VIRUS BOMBYX-MORI *NUCLEAR* *POLYHEDROSIS* VIRUS GENE MAPPING PROMOTER TRANSCRIPTION DIRECTION HOMOLOGY GRANULIN GENE TRANSFER RNA GENE NUCLEOTIDE SEQUENCE AMINO ACID SEQUENCE MOLECULAR SEQUENCE DATA.

ZUIDEMA-D. VAN-OERS-M-M. VAN-STRIEN-E-A. CABALLERO-P-C. KLOK-E-J. GOLDBACH-R-W. VLAK-J-M.
NUCLEOTIDE SEQUENCE AND TRANSCRIPTIONAL ANALYSIS OF THE P10 GENE OF SPODOPTERA-EXIGUA *NUCLEAR* *POLYHEDROSIS* VIRUS.
J GEN VIROL 74 (6). 1993. 1017-1024.
JOURNAL OF GENERAL VIROLOGY.
ABSTRACT
The p10 gene of Spodoptera exigua multiple *nuclear* *polyhedrosis* virus (SeMNPV) was localized on the XbaI fragment H (5.1 kb) of the physical map of the viral genome. The coding sequence of the SeMNPV p10 gene is 264 nucleotides (nt) long corresponding to a predicted protein of 88 amino acids with an MHF of 9607. The SeMNPV p10 protein showed only limited amino acid identity (39% and 26%, respectively) to those of *Orgyia* *pseudotsugata* MNPV (OpMNPV) and Autographa californica MNPV (AcMNPV) and thus appears less conserved than other viral proteins. The SeMNPV p10 gene was expressed by a transcript of

approximately 450 nt, which started in the conserved baculovirus late gene promoter motif TAAG. The leader of the SeMNPV p10 transcript was AT-rich (92 %) and at 36 nt was the shortest leader of all baculovirus major late genes reported so far. The SeMPNV p10 transcript terminated 6 nt downstream from a putative poly(A) signal sequence (AATAAA); the latter was 61 nt downstream of the translational stop codon TAA. Upstream and downstream of the p10 gene, partial putative ORFs were found that showed significant amino acid sequence identity to the baculovirus p26 and p74 proteins. It is concluded that the region of SeMNPV DNA containing the p10 gene is collinear with the corresponding regions in the AcMNPV and OpMNPV genomes

Keywords/AUTOGRAPHA-CALIFORNICA *NUCLEAR* *POLYHEDROSIS* VIRUS *ORGYIA-PSEUDOTSUGATA* MULTIPLE *NUCLEAR* *POLYHEDROSIS* VIRUS MOLECULAR SEQUENCE DATA AMINO ACID SEQUENCE GENBANK-X69615 EMBL-X69615 HOMOLOGY LEADER SIZE.